

NOTICE INVITING TENDER

FOR

**CONSTRUCTION OF 220 KV LILO GIS AT
TALCHER FERTILIZERS LTD, ODISHA
(OPEN DOMESTIC COMPETITIVE BIDDING)**

(NIT NO : PNMM/PC-183/E- 4024/NCB)



TALCHER FERTILIZERS LIMITED

**[A JOINT VENTURE OF M/s GAIL (INDIA) LIMITED (GAIL), M/s RASHTRIYA
CHEMICALS & FERTILIZERS LTD. (RCF), M/s COAL INDIA LTD. (CIL),
& M/s FERTILIZER CORPORATION OF INDIA LTD (FCIL)]**



ISSUED BY



**PROJECTS & DEVELOPMENT INDIA LTD.
(A Govt. Of India Enterprise)
PDIL BHAWAN, A-14, Sector-1,
NOIDA U.P. (India)**



12.01.2024





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		DOC. NO.	REV.	
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INVITATION FOR BID (IFB)

SECTION-I
"INVITATION FOR BID (IFB)"

Ref No: PNMM/PC-183/E-4024/NCB

Dated: 12.01.2024

To,

PROSPECTIVE BIDDERS

SUB: CONSTRUCTION OF 220 KV LILO GIS AT TALCHER FERTILIZERS LTD, ODISHA

Dear Sir/Madam,

1.0 **INTRODUCTION:**

- 1.1 GAIL (India) Limited (GAIL), Rashtriya Chemicals & Fertilizers Limited (RCF), Coal India Limited (CIL) and Fertilizer Corporation of India Limited (FCIL) have formed a Joint Venture company in the name of Talcher Fertilizers Limited (TFL) hereinafter also referred to as "Owner", intends to carry out the work of **Construction of 220 KV LILO GIS on item rate basis** for its Ammonia Urea Plant, an integrated fertilizer and chemical complex comprising of Coal Gasification and Gas Purification Unit, Ammonia Synthesis Unit, Urea Plant, along with necessary offsite and utility facilities at Talcher Unit, Angul district, in the state of Odisha, India.
- 1.2 GAIL (India) Limited is a Public Sector Unit under the Ministry of Petroleum & Natural Gas and Rashtriya Chemicals & Fertilizers Limited (RCF) & Fertilizer Corporation of India Limited (FCIL) are two Public Sector Units under the Ministry of Chemicals & Fertilizers and Coal India Limited (CIL) is a Public Sector Unit under the Ministry of Coal, Govt. of India.
- 1.3 Projects and Development India Limited (PDIL), hereinafter referred to as PROJECT MANAGEMENT CONSULTANT (PMC) on behalf of M/s Talcher Fertilizers Ltd. (TFL), hereinafter referred as OWNER, has the pleasure of inviting bids from eligible domestic bidders to submit Bid ONLINE through Central Public Procurement (CPP) Portal under Single Stage Two Bid System, for the subject works.
- 1.4 "PTC India Limited" hereinafter referred to as CONSULTANT, has been retained by M/s Talcher Fertilizers Ltd. (TFL), hereinafter referred as OWNER for providing consultancy services for **"Construction of 220 KV LILO GIS on item rate basis"**.

2.0 The brief details of the tender are as under:

(A)	NAME OF WORK / BRIEF SCOPE OF SERVICE/JOB	CONSTRUCTION OF 220 KV LILO GIS AT TALCHER FERTILIZERS LTD				
(B)	NIT NO. & DATE	PNMM/PC-183/E-4024/NCB DATED 12.01.2024				
(B1)	TYPE OF TENDER	OPEN DOMESTIC COMPETITIVE BIDDING				
(C)	TYPE OF BIDDING SYSTEM	<table border="1"> <tr> <td>SINGLE BID SYSTEM</td> <td><input type="checkbox"/></td> </tr> <tr> <td>TWO BID SYSTEM</td> <td><input checked="" type="checkbox"/></td> </tr> </table>	SINGLE BID SYSTEM	<input type="checkbox"/>	TWO BID SYSTEM	<input checked="" type="checkbox"/>
SINGLE BID SYSTEM	<input type="checkbox"/>					
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(D)	TYPE OF TENDER	<table border="1"> <tr> <td>E-TENDER (CPP PORTAL)</td> <td><input checked="" type="checkbox"/></td> </tr> <tr> <td>MANUAL</td> <td><input type="checkbox"/></td> </tr> </table>	E-TENDER (CPP PORTAL)	<input checked="" type="checkbox"/>	MANUAL	<input type="checkbox"/>
E-TENDER (CPP PORTAL)	<input checked="" type="checkbox"/>					
MANUAL	<input type="checkbox"/>					
(E)	COMPLETION PERIOD	Please Refer Clause 14.0 of SPECIAL CONDITIONS OF CONTRACT.				
(F)	BID SECURITY /EARNEST MONEY DEPOSIT (EMD}	<table border="1"> <tr> <td>APPLICABLE</td> <td><input checked="" type="checkbox"/></td> </tr> <tr> <td>NOT APPLICABLE</td> <td><input type="checkbox"/></td> </tr> </table> <p>EMD value: Rs. 56.82 Lakh (Rupees Fifty Six Lakh and Eighty Two Thousand Only)</p> <p>Exempted Bidders (i.e. Start-ups and Govt Dept./PSUs) are required to submit declaration for Bid security as per Form F-2B (Refer clause no.16 of ITB).</p>	APPLICABLE	<input checked="" type="checkbox"/>	NOT APPLICABLE	<input type="checkbox"/>
APPLICABLE	<input checked="" type="checkbox"/>					
NOT APPLICABLE	<input type="checkbox"/>					
(G)	AVAILABILITY OF TENDER DOCUMENT ON WEBSITE(S)	(i) CPP Portal (https://eprocure.gov.in/eprocure/app) (ii) TFL Website - http://tflonline.co.in (iii) PDIL website - www.pdilin.com				
(H)	LAST DATE OF RECEIPT OF BIDDER'S PRE-BID QUERIES	Not Applicable				

(I)	DATE, TIME OF PRE-BID MEETING (Through Video Conferencing)	19.01.2024 at 15:00 Hrs (IST) Click here to join the meeting
(J)	BID SUBMISSION START DATE	24.01.2024 at 15:00 Hrs (IST)
(K)	BID CLOSING DATE	05.02.2024 at 15:00 Hrs. (IST)
(L)	BID OPENING DATE	06.02.2024 at 15:00 Hrs. (IST)
(M)	Address for Communication	
(i)	PDIL	M/s Projects & Development India Limited, P.D.I.L Bhawan, A-14, Sector-1, Noida, (PIN 201301) Dist. Gautam Budh Nagar (UP). (India) Kind Attention: Mrs. Anjali Thakur, Dy. General Manager (M.M) Fax no. : +91-120-2529801 Tel no. : +91-120-2529842 E-mail : anjali@pdilin.com alam@pdilin.com
(ii)	TFL	M/s Talcher Fertilizers Ltd. (TFL), Administrative Building, Talcher, Post: Vikrampur, Dist: Angul, Pincode.759106, Odisha Kind Attention : Mr. Satyabrata Mishra General Manager (Projects) Tel No. : +91-9927339444 E-mail : smishra@gail.co.in ; vivekmishra@tflonline.co.in
(N)	Original Documents to be submitted at	Projects & Development India Limited, (Materials Management Department) P.D.I.L Bhawan, A-14, Sector-1, Noida, (PIN 201301) Dist. Gautam Budh Nagar (UP). (India) Kind Attention: Mrs. Anjali Thakur , Addl. General Manager (M.M) Fax no. : +91-120-2529801 Tel no. : +91-120-2529842 E-mail : anjali@pdilin.com

(O)	Contact Person for Site visit	M/s Talcher Fertilizers Ltd. (TFL), Administrative Building, Talcher, Post: Vikrampur, Dist: Angul, Pincode-759106, Odisha Kind Attention: Mr. Satyabrata Mishra General Manager (Projects) Tel No. : +91-9927339444 E-mail : smishra@gail.co.in
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In case the days specified above happens to be a holiday in TFL/PDIL, the next working day shall be implied.


- 3.0 Bids must be submitted strictly in accordance with Clause No. 11 of ITB (Section-III of tender) depending upon Type of Tender as mentioned at Clause no. 2.0 (D) above. The IFB is an integral and inseparable part of the bidding document.
- 4.0 Bid must be submitted only on CPP Portal (<https://eprocure.gov.in/eprocure/app>). Further, the following documents in addition to uploading the bid on CPPP's Portal shall also be submitted in Original (in physical form) within 7 (seven) days(*) from the bid due date, provided the scanned copies of the same have been uploaded in e-tender by the bidder along with e-bid within the due date and time to the address mentioned in Clause no. 2.0 (M) of IFB:-
- i) EMD (for all bidders except exempted category) /Declaration for Bid Security (for exempted bidders)
 - ii) Power of Attorney
 - iii) Integrity Pact
 - iv) TPI Letter
 - v) Line of Credit (If applicable)
- 5.0 Bidder(s) are advised to quote strictly as per terms and conditions of the tender documents and not to stipulate any deviations/exceptions.
- 6.0 Any bidder, who meets the Bid Evaluation Criteria (BEC) and wishes to quote against this Tender Document, may download the complete Tender Document along with its amendment(s) if any from websites as mentioned at 2.0 (G) of IFB and submit their Bid complete in all respect as per terms & conditions of Tender Document on or before the Due Date & Time of Bid Submission.
- 7.0 Bid(s) received from bidders to whom tender/information regarding this Tender Document has been issued as well as offers received from the bidder(s) by downloading Tender Document from above mentioned website(s) shall be taken into consideration for evaluation & award provided that the Bidder is found responsive subject to provisions contained in Clause No. 2 of ITB (Section-III of tender).

The Tender Document calls for offers on single point "Sole Bidder" responsibility basis (except where JV/Consortium bid is allowed pursuant to clause no. 3.0 of ITB) and in total compliance of Scope of Works as specified in Tender Document.

- 8.0 Any revision, clarification, corrigendum, time extension, etc. to this Tender Document will be hosted on the website(s) only as mentioned at 2.0 (G) of IFB. Bidders are requested to visit the CPP Portal regularly to keep themselves updated. No complaint/representation shall be entertained from bidders in case they do not see / download the amendments, etc. issued to the tender document by TFL from time to time on the CPP Portal.
- 9.0 All bidders who are willing to submit their bid are required to submit F-6 (Acknowledgement cum Consent letter) duly filled within 7 days from date of receipt of tender information.

This is not an Order.

Thanking You,
For and on behalf of
Talcher Fertilizers limited

 12/01/2024

(Anjali Thakur)
Dy. General Manager (M.M)
Projects & Development India Limited

PHYSICAL DOCUMENTS (EMD/Declaration for Bid Security, POA, Integrity Pact & TPIA Letter)

Tender Document No. : PNMM/PC-183/E-4024/NCB dated 12.01.2024

Description : CONSTRUCTION OF 220 KV LILO GIS AT TALCHER FERTILIZERS LTD, ODISHA

Due Date & Time : 02.02.2024 at 15:00 hrs.

From:	To: M/s Projects & Development India Limited, P.D.I.L Bhawan, A-14, Sector-1, Noida, (PIN 201301) Dist. Gautam Budh Nagar (UP). (India) Kind Attention: Mrs. Anjali Thakur Dy. General Manager(M.M)
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(To be pasted on the envelope containing Physical Document)



SECTION-II

BID EVALUATION CRITERIA

&

EVALUATION METHODOLOGY

SECTION-II

1.0 BID EVALUATION CRITERIA (BEC)

Bids are hereby invited from competent Domestic Bidders meeting the technical and financial criteria of respective BEC stated hereunder.

Evaluation of Techno-Commercial offers shall be carried out for only those Bidders who shall meet the BEC.

(A) Technical Criteria:

A.1 The bidder must have completed at least One or Two or three “**Similar work*****”, during the last Seven (07) years reckoned from the original bid opening date

(i) The bidder must have completed One “**Similar work**”, having at least Five (05) Nos. GIS Circuit Breaker Bays* of 220KV or above voltage class.

OR

(ii) The bidder must have completed Two “**Similar work**”, each having at least Three (03) Nos. GIS Circuit Breaker Bays* of 220KV or above voltage class

OR

(iii) The bidder must have completed Three “**Similar work**”, each having at least Two (02) Nos. GIS Circuit Breaker Bays* of 220KV or above voltage class.

(*) One number of GIS Circuit Breaker Bay shall be considered as a bay used for controlling a line or a transformer or a reactor or a bus section or a bus coupler and comprising of at least one circuit breaker, one disconnecter and three numbers of single phase CTs / Bushing CTs.

“**Similar work**” shall mean the following:

(i) Design/ Engineering/ Detail Engineering, Supply/ Procurement, Erection/ Installation, Testing/ Commissioning including Civil work of 220 KV, or above voltage class, Indoor Double Bus Gas Insulated Switchgear (GIS) Substation / GIS Switchyard.

In case, the bidder does not meet the ‘Design/ Engineering/ Detail Engineering’ with respect to above ‘Similar work’, the bidder shall still be considered, provided:

a) The bidder should have experience of Procurement, Erection/ Installation, Testing/ Commissioning including civil works of 220kV or above voltage class Indoor Double Bus Gas Insulated Substation (GIS) / (G/S) Switchyard.

- b) Bidder engages a back-up consultant/technical collaborator/agency for design and engineering of “220kV voltage class Indoor Double Bus Gas Insulated Substation (GIS) / (GIS) Switchyard”, who meets the requirement in respect of design and engineering of 220kV or above voltage class Indoor Double Bus Gas Insulated Substation (GIS)/(GIS)Switchyard. However, the ultimate responsibility lies with the bidder.
- c) The bidders furnish along with his bid the MoU (or Letter of Agreement or letter of consent) with the above back-up consultant/technical collaborator/agency/. Above back-up consultant/ technical collaborator/agency shall not be changed thereafter.

Further, if in case, the bidder does not meet the requirement of ‘Civil work’ with respect to above ‘Similar work’, the bidder shall still be considered, provided:

- a) The bidder should have experience of Design/ Engineering/ Detail Engineering, Supply/ Procurement, Erection/ Installation, Testing/ Commissioning of 220 KV, or above voltage class, Indoor Double Bus Gas Insulated Switchgear (GIS) Substation / GIS Switchyard
- b) Bidder engages a back-up agency for ‘Civil Works’, who meets the requirement in respect of Civil Works of ‘220kV or above voltage class Indoor Double Bus Gas Insulated (GIS) Substation/ GIS Switchyard. However, the ultimate responsibility lies with the bidder.
- c) The bidders furnish along with his bid the MoU (or Letter of Agreement or letter of consent) with the above back-up consultant/technical collaborator/agency/. Above back-up consultant/ technical collaborator/agency shall not be changed thereafter.

A.2 The said “**Similar Work**” referred at **A.1** as stated above must have been in operation for at least 1 (one) year as on the original bid opening date from the Date of Acceptance / Commissioning of the works.

A.3 Applicability of Policy for providing preference to Domestically Manufactured Iron & Steel (DMI & SP) products.

Bidder should have minimum prescribed domestic value addition requirement in line with the Domestic Manufactured iron & Steel Policy (DMI & SP) for the Iron & Steel products involved in execution of the contract. Bidder shall submit affidavit from the domestic manufacturers of such Iron & steel products as per the Form-I mentioned in the policy document.

A bidder who is not manufacturer of Iron & Steel product and is unable to submit the Affidavit from domestic manufacturers at bidding stage, such bidder can submit the Affidavit issued by domestic manufacturers after placement of order. In this case bidder along with his bid shall submit an undertaking as per attached format in NIT.

If a bidder does not submit above affidavit/ undertaking as per format, the offer of bidder shall be rejected.

Additional Notes to Technical Criteria:

- I. Job completed by a Bidder for its own plant/ project cannot be considered as experience for the purpose of meeting BEC of the tender. However, jobs completed for Subsidiary/ Fellow subsidiary/ Holding company will be considered as experience for the purpose of meeting BEC subject to submission of tax paid invoice(s) duly certified by Statutory Auditor of the Bidder towards payments of statutory tax in support of the job completed for Subsidiary/ Fellow subsidiary/ Holding company. Such Bidders to submit these documents in addition to the documents specified to meet BEC.
- II. The bidder must submit the completion certificate/acceptance certificate issued by Order issuing authority/end user/ owner (or their consultant who has been duly authorized by them to issue such certificate) only after completion of work/ supply in all aspects.
- III. Only documents (Work order, completion certificate, execution certificate etc.) which have been referred /specified in the bid shall be considered in reply to the queries during evaluation of bids.
- IV. In case more than one contract/order/agreement/DLOA are emanating against same tender, these contracts are to be considered as single contract for evaluation of credentials of a bidder for meeting their experience criteria.
- V. Experience of bidder acquired as a subcontractor is acceptable against submission of certificate from End User/ Owner by such bidder along with other specified documents.
- VI. Bids from Consortium/ Joint Venture shall not be accepted.
- VII. If a Bidder has executed "Similar work" in the capacity of Joint Venture/ Consortium partner, his experience shall be considered to the extent of scope of work defined under the Joint Venture/ Consortium Agreement.

(B) Financial Criteria:

- B.1** The Average Annual Turnover of the bidder in any one of the last three (03) preceding financial years should be at least **INR 33.52 Crore**.
- B.2** Net Worth of the bidder should be positive as per last audited financial year.
- B.3** The Bidder should have minimum working capital equal to **INR 6.70 Crore** as per last audited financial year. However, if the bidder's working capital is negative or inadequate, the bidder shall submit a letter from their Bank having Net worth of the bank not less than Rs. 100.0 Crore (or equivalent USD), confirming the availability of line of credit for **INR 6.70 Crore**. The line of credit from bank shall be submitted strictly as per prescribed format.

“Notes for B.1, B.2 & B.3”

Average Annual Turnover: Preceding 3 financial years mentioned in aforesaid BEC refer to immediate 3 preceding financial years wherever the closing date of the bid is after 30th Sept. of the relevant financial year. In case the tenders having the due date for submission of bid up to 30th September of the relevant financial year, and audited financial results of the immediate 3 preceding financial years are not available, the audited financial results of the 3 years immediately prior to that will be considered.

In case the date of constitution/incorporation of the bidder is less than 3 years old, the average turnover in respect of the completed financial years after the date of constitution/incorporation shall be taken into account for minimum Average Annual Financial Turnover criteria.

Net Worth/Working Capital: Immediate preceding financial year mentioned in aforesaid BEC refer to audited financial results for the immediate preceding financial year wherever the closing date of the bid is after 30th September of the relevant financial year. In case the tenders having the due date for submission of bid up to 30th September of the relevant financial year, and audited financial results of the immediate preceding financial year is not available, in such case the audited financial results of the year immediately prior to that year will be considered.

Bidder is to submit Audited Financial Statement of immediate preceding financial years (as mentioned above) along with format F-10 accordingly for Networth / Working Capital.

Any shortfall information / documents on the Audited Annual Report / Financial Statement of the Bidder and/or line of credit for working capital issued on or before the final bid due date can only be sought against Commercial queries (CQs). Any information/ documents issued post final bid due date shall not be considered for evaluation.

(C) General Notes (for both Technical BEC and Financial BEC) wherever applicable:

Exchange rate for conversion of currency for evaluation of documents relating to BEC (if applicable):

Exchange rate for Conversion of Currency for evaluation of documents submitted by bidders for BEC which are in a currency other than INR, shall be as follows:

a) **BEC (Technical):** Bill Selling (foreign exchange) Rate of State Bank of India as prevailing on the date of award of order / contract submitted by bidder.

b) **BEC (Financial)**

(i) **For Annual Turnover:** The average of Bill Selling (foreign exchange) Rate of State Bank of India as prevailing on the First date and Last date of the respective Financial Year.

(ii) **For Net Worth & Working Capital:** The Bill Selling (foreign exchange) Rate of State Bank of India as prevailing on the Last date of the respective Financial Year

c) In case, the SBI Selling rate is not available as on the date of conversion as specified above for respective cases, the exchange rate for conversion of currency shall be taken from the internet, such as -

<https://www.xe.com/currencyconverter>

<https://economictimes.indiatimes.com/markets/forex/currency-converter>

<https://www.oanda.com/currency/converter>

(D) BEC for START-UPS:

The Technical and Financial BEC as stipulated above shall also be applicable for start-ups.

(E) Documents to be submitted for Compliance to BEC

(i) Technical Criteria of BEC:

To meet the criteria of **A.1**, above, Bidder must submit copy of Detailed Letter of Acceptance (DLOA) / Work Order /relevant extract of work Order/ Contract Agreement along with detailed scope of work and Completion / Acceptance Certificate. Such certificate shall be issued by order issuing authority Owner/End user.

The Detailed Letter of Acceptance (DLOA) / Work Order / Contract Agreement must *inter alia* include Scope of work, completion time, contract value, etc. Similarly, the Completion Certificate/ Acceptance Certificate must clearly indicate reference of relevant work order/DLOA/Contract Agreement, Name of Work, Completed order value and date of completion.

To meet the criteria of **A.2**, above a certificate in respect of minimum one year successful operation of the Plant/ System from the date of acceptance/Commissioning of work issued by the Owner/End user is to be submitted by the Bidder.

Memorandum of understanding (MoU) (or letter of Agreement or Letter of Consent)/Agreement document, copy of work order/completion certificate etc. with backup consultant/Technical Collaborator/Agency to meet the requirement of clause no. **A.1** Similar work

In cases where bidder has executed the "Similar work" as a sub-contractor, such Completion certificate and Operation certificates (for compliance to **A.1** above) issued by the "Order issuing Authority" is also acceptable, provided that a certificate or letter from the End User/Owner is submitted that the bidder has worked as a sub-contractor for that project.

To meet the criteria **A.3** above, Bidder shall submit affidavit from the domestic manufacturers of Iron & steel products as per the Form-I enclosed with the policy documents. A bidder who is not manufacturer of Iron & Steel product and is unable to submit the Affidavit from domestic manufacturers at bidding stage, such bidder can submit the Affidavit issued by domestic manufacturers after placement of order. In this case bidder along with his bid shall submit an undertaking as per prescribed format.

Any other documents to establish the bidder meets BEC requirements.

Note: Above is indicative list of documents. Bidder shall ensure that all requisite documents are furnished in the bid to justify qualification of bidder with respect to bidder qualification requirements.

(ii) Financial Criteria of BEC:

- (a) To meet the criteria for Sr. No. **B.1**, Bidder shall submit the Audited Financial Statements of the company for last three (03) preceding financial years.
- (b) To meet the criteria for Sr. No. **B.2**, Bidder shall submit the Audited Financial Statements of the last financial year.
- (c) To meet the criteria for Sr. No. **B.3**, Bidder shall submit the Audited Financial Statements of last financial year along with (i) Bank's Letter (if applicable)
- (d) If the bidder's working capital is negative or inadequate, the bidder shall submit a letter from their bank having net worth not less than Rs.100 Crores (or equivalent USD), confirming the availability of line of credit for working capital amount mentioned herein above. The line of credit letter from bank to be submitted strictly as per prescribed format.

For E (ii) above, the "Notes for B.1, B.2 & B.3 under B" (Financial Criteria of BEC) shall apply.

- (iii) Bidder shall submit Checklist as per prescribed format in respect of documents to be submitted by bidder towards BEC.

(F) Authentication of documents submitted against BEC

1. Technical BEC

All documents in support of “Technical Criteria” of Bid Evaluation Criteria (BEC) furnished by the bidders shall be verified and certified by any one of the following independent third party inspection agency (as per prescribed format):

1. Société Générale de Surveillance (SGS)
2. Gulf Lloyds Industrial Services (India) Pvt. Ltd (GLISPL)
3. International Certification Services (ICS)
4. Bureau Veritas (Ind.) Pvt. Ltd (BVIS)
5. DNV GL
6. TÜV Rheinland (India) Pvt. Ltd.
7. TÜV SÜD South Asia Pvt. Ltd.
8. TÜV India Pvt. Ltd. (TÜV Nord Group)
9. Intertek India Pvt. Ltd.
10. Moody International (India) Pvt. Ltd.
11. RINA India Pvt. Ltd.
12. Tata Projects Ltd.
13. Competent Inspectorate and Consultants LLP
14. ABS Industrial Verification (India) Pvt. Ltd

Further, TPIA will provide in addition a certificate toward verification and certification of documents pertaining to Technical Bid Evaluation Criteria (BEC) as per prescribed proforma and the same will be submitted by bidder in their bid.

All charges of the Third party for verification and certification shall be borne by the Bidder.

If any above mentioned agency themselves are participating in bidding, then they shall authenticate the documents by a different agency from the list given above.

2. Financial BEC

Bidder shall submit “Details of financial capability of Bidder” in prescribed format (F-10) duly signed and stamped by a chartered accountant/ Certified Public Accountant (CPA).

Further, copy of audited annual financial statements submitted in bid shall be duly certified/ attested by Notary Public with legible stamp.

2.0 EVALUATION METHODOLOGY:

The subject work is indivisible and complete work shall be awarded to successful overall lowest bidder as per evaluation methodology described below.

- (i) Total quoted price as per SOR inclusive of all taxes & duties including GST after arithmetic correction of errors (if any).
- (ii) In case any cess on GST is applicable, same shall also be considered in evaluation.
- (iii) In case any unregistered bidder is submitting their bid, their prices will be loaded with applicable GST (CGST & SGST/UTGST or IGST) while evaluation of bid (if applicable as per Govt. Act/Law in vogue).
- (iv) The Price Evaluation will be subject to applicability of Purchase Preference Policies as mentioned in the tender document.

Note: In case e-Reverse Auction (eRA) becomes applicable (i.e. in case 4 or more techno-commercially acceptable bids are received), then eRA shall be conducted on the "Total overall cost" basis. Break up of prices after eRA will not be sought and rate of each item of SOR shall be worked out after applying uniform reduction (i.e. based on total price received after eRA and original total evaluated price). While working out rate of each items, unit rate upto two decimals only will be considered and the figures beyond two decimals shall be ignored without rounding off (e.g. if item rates after applying uniform reduction works out to 10.910 or 10.912 or 10.915 or 10.919, the rate will be considered as 10.91).

3.0 Applicability of Public Procurement (Make in India) Policy

The said policy shall be applicable for this package. Further, as the work is non divisible/non-splittable, therefore, the relevant provisions of policy shall be applicable. The minimum local content and all other provisions shall be as per Public Procurement (Make in India) Policy [latest policy no. P-45021/2/2017-PP (BE-II) dated 16th September, 2020 or as updated from time to time].

4.0 Applicability of purchase preference of MSE's

Considering that the subject work falls under "Works Contract", Purchase preference & exemption of EMD to MSE's Bidders shall not be applicable as per government guidelines.

Format for Undertaking from TPIA
(on TPIA letter head duly stamped & signed)

Ref.:

Date :

To,

Talcher Fertilizers Limited.

.....
.....
.....

Dear Sir,

Subject: Verification and certification of documents pertaining to Technical Bid Evaluation Criteria (BEC)

Ref : Tender no. for

M/s.having Registered office at.....intend to participate in above referred tender of Talcher Fertilizers Limited having its registered office at Plot 2/H, Kalpana Area, BJB Nagar, Khordha, Bhubaneswar-751014.

The tender conditions stipulates that the BIDDER shall submit Documents pertaining to Technical Bid Evaluation Criteria (BEC) duly verified and certified by designated independent Third Party Inspection Agency.

In this regard, this is to certify that copies of documents pertaining to Technical Bid Evaluation Criteria (BEC) submitted to us by the bidder have been verified and certified by us with the originals and found to be genuine. We have signed and stamped on the copies of all the verified and certified documents.

(Signature of a person duly authorized to

Sign on behalf of the TPIA)

(Seal of the Company)

Name:

Contact No.....

**POLICY FOR PROVIDING PREFERENCE TO DOMESTICALLY
MANUFACTURED IRON & STEEL PRODUCTS
IN GOVERNMENT PROCUREMENT**



भारत का राजपत्र The Gazette of India

असाधारण

EXTRAORDINARY

भाग II—खण्ड 3—उप-खण्ड (i)

PART II—Section 3—Sub-section (i)

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अधिसूचना

नई दिल्ली, 29 मई, 2019

सा.का.नि. 385(अ).—घरेलू रूप से उत्पादित किए जाने वाले लौह एवं स्टील उत्पाद की सरकारी खरीद को प्राथमिकता दिए जाने के लिए संशोधित नीति सामान्य सूचना हेतु प्रकाशित की जाती है।

[फा. सं. 3(2)/2018-आईडीडी]

रसिका चौबे, अपर सचिव

सरकारी खरीद में घरेलू स्तर पर निर्मित लौह एवं इस्पात उत्पादों को बरीयता देने के लिए नीति - संशोधित, 2019

1. भूमिका

- 1.1 यह नीति सरकारी खरीद में घरेलू स्तर पर निर्मित लौह एवं इस्पात उत्पादों (डी एम आई एंड एस पी) को बरीयता देती है।
- 1.2 यह नीति यथा लागू निर्धारित गुणवत्ता मानदंडों के अनुपालन में उत्पादित लौह एवं इस्पात उत्पादों जिसे परिशिष्ट क में दिया गया है और परिशिष्ट ख में दिए गए लौह एवं इस्पात उत्पादों के लिए पूंजीगत माल पर लागू होती है।
- 1.3 यह नीति सरकार के प्रत्येक मंत्रालय अथवा विभाग और उनके प्रशासनिक नियंत्रण के अधीन सभी एजेंसियों/प्रतिष्ठानों तथा सरकारी परियोजनाओं के वास्ते लौह एवं इस्पात उत्पादों की खरीद के लिए इन एजेंसियों द्वारा वित्त पोषित परियोजनाओं पर लागू है। हालांकि, यह नीति वाणिज्यिक पुनः बिक्री के उद्देश्य से अथवा वाणिज्यिक बिक्री के लिए वस्तुओं के उत्पादन में उपयोग करने के उद्देश्य से लौह एवं इस्पात उत्पादों की खरीद पर लागू नहीं होगी।

2. परिभाषाएं

- 2.1 **बोली** लगाने वाला लौह एवं इस्पात का कोई घरेलू/विदेशी निर्माता अथवा उनके बिक्री एजेंट/अधिकृत वितरक/अधिकृत डीलर/अधिकृत आपूर्ति गृह अथवा सरकारी एजेंसियों द्वारा वित्त पोषित निधि परियोजनाओं की बोली लगाने में कार्यरत कोई अन्य कंपनी हो सकती है।

- 2.2 **घरेलू स्तर पर निर्मित लौह एवं इस्पात उत्पाद (डी एम आई एंड एस पी)** वे लौह एवं इस्पात उत्पाद हैं जिनका निर्माण उन प्रतिष्ठानों द्वारा किया जाता है जो भारत में पंजीकृत और स्थापित हैं, जिसमें विशेष आर्थिक क्षेत्र (एम ई ज़ेड) शामिल है। इसके अलावा, इस प्रकार के उत्पाद परिशिष्ट क में किये गये उल्लेख के अनुसार घरेलू न्यूनतम मूल्यवर्धन के मानदंडों को पूरा करेंगे।
- 2.3 **घरेलू निर्माता** खंड 7 में दिशा-निर्देशों और केंद्रीय उत्पाद शुल्क अधिनियम में दी गई 'निर्माता' की परिभाषा के अनुरूप लौह एवं इस्पात उत्पादों का एक निर्माता है।
- 2.4 इस नीति के प्रयोजन से **सरकार** का तात्पर्य भारत सरकार से है।
- 2.5 **सरकारी एजेंसियों** में सरकार के सार्वजनिक क्षेत्र के उपक्रम, सरकार द्वारा स्थापित सोसायटी, ट्रस्ट और सांविधिक निकाय शामिल हैं।
- 2.6 **एम ओ एस** का आशय इस्पात मंत्रालय, भारत सरकार से है।
- 2.7 **निवल बिक्री कीमत** बीजक कीमत होगी जिसमें निवल घरेलू कर और शुल्क शामिल नहीं होंगे।
- 2.8 **अर्ध तैयार इस्पात** का तात्पर्य इनगोट्स, बिलेट, ब्लूम और स्लेब्स से है, जिसे बाद में प्रसाधित कर तैयार इस्पात बनाया जा सकता है।
- 2.9 **तैयार इस्पात** का तात्पर्य सपाट और लंबे उत्पादों से होगा जिन्हें बाद में प्रसाधित कर निर्मित मद बनाया जा सकता है।
- 2.10 **एल1** का तात्पर्य निविदा अथवा अन्य खरीद संबंधी अनुरोध के अनुसार मूल्यांकन प्रक्रिया में यथाघोषित निविदा, बोली लगाने संबंधी प्रक्रिया अथवा अन्य खरीद संबंधी अनुरोधों में प्राप्त निम्नतम निविदा अथवा निम्नतम बोली अथवा निम्नतम भाव से होगा।
- 2.11 **खरीद वरीयता के मार्जिन** का तात्पर्य उस अधिकतम सीमा से है जिस सीमा तक किसी घरेलू आपूर्तिकर्ता द्वारा लगाई गई कीमत खरीद वरीयता के प्रयोजन से एल1 से अधिक हो। डी एम आई एंड एस पी नीति के मामले में, खरीद वरीयता का मार्जिन परिशिष्ट ख में मदों के लिए 20 प्रतिशत होगा।
- 2.12 **लौह एवं इस्पात उत्पाद** का तात्पर्य ऐसे लौह एवं इस्पात उत्पादों से होगा जिनका उल्लेख परिशिष्ट क में किया गया है।
- 2.13 **घरेलू मूल्यवर्धन** निवल बिक्री कीमत (निवल घरेलू करों और शुल्कों को छोड़कर बीजक कीमत) होगी जिससे प्रतिशत में निवल बिक्री कीमत के एक अनुपात के रूप में भारत में निर्माण संयंत्र (सभी सीमा शुल्कों सहित) में आयात की गई इनपुट सामग्री की पहुंच लागत घटाई गई हो, 'घरेलू मूल्यवर्धन' परिभाषा डी पी आई आई टी (पूर्व में डी आई पी पी) के दिशानिर्देशों के अनुरूप होगी और उसमें भविष्य में डी पी आई आई टी द्वारा परिवर्तन किये जाने की स्थिति में उपयुक्त रूप से संशोधन किया जाएगा। इस नीति दस्तावेज के प्रयोजन के लिए घरेलू मूल्यवर्धन और स्थानीय विषय वस्तु का उपयोग एक दूसरे के स्थान पर किया गया है।
- 3. अपवर्जन**
- 3.1 इस्पात मंत्रालय द्वारा इस प्रकार की सभी सरकारी खरीदों के लिये निम्नलिखित शर्तों के अधीन छूट प्रदान की जाएगी।
- 3.1.1 जहां विशिष्ट शेडों के इस्पात का निर्माण इस देश में नहीं किया जाता हो, अथवा
- 3.1.2 जहां परियोजना की मांग के अनुसार इन मात्राओं को घरेलू स्रोतों के माध्यम से पूरा नहीं किया जा सकता हो।
- अपवर्जन संबंधी अनुरोधों को घरेलू स्तर पर निर्मित लौह एवं इस्पात उत्पादों के उपलब्ध न होने के पर्याप्त प्रमाण के साथ स्थायी समिति को प्रस्तुत किया जाएगा।
- 4. स्थायी समिति**
- इस नीति के कार्यान्वयन का पर्यवेक्षण करने के लिए इस्पात मंत्रालय (एम ओ एस) के अधीन एक स्थायी समिति का गठन किया जाएगा। जिसके अध्यक्ष सचिव इस्पात होंगे। इस समिति में उद्योग/उद्योग संघ/सरकारी संस्था अथवा निकाय/इस्पात मंत्रालय (एम ओ एस) से लिए गए विशेषज्ञ होंगे। इस्पात मंत्रालय में उक्त समिति के पास निम्नलिखित के लिए अधिदेश होगा :
- 4.1 इस नीति के कार्यान्वयन की मॉनीटरिंग करना
- 4.2 परिशिष्ट क और परिशिष्ट ख में यथा उल्लिखित लौह एवं इस्पात उत्पादों की सूची और घरेलू बिक्री वर्धन की आवश्यकता से संबंधित मानदंडों की समीक्षा करना और उसे अधिसूचित।

- 4.3 खंड 3 के अनुसार खरीद एजेंसियों को अपवर्जन की स्वीकृति देने सहित इस नीति के कार्यान्वयन के लिए आवश्यक स्पष्टीकरण जारी करना।
- 4.4 शिक्कायत निवारण करने के लिए एक अलग समिति का गठन करना।
- 4.5 स्थायी समिति इस्पात मंत्रालय को अनुमोदन हेतु अपनी सिफारिशें प्रस्तुत करेगी।
- 5. सरकार द्वारा खरीदे जाने वाले लौह एवं इस्पात उत्पादों को अधिसूचित करना**
- 5.1 निम्नलिखित दिशानिर्देशों का उपयोग इस नीति के अंतर्गत उपरोक्त उत्पादों की पहचान करने और उमें अधिसूचित करने के लिए किया जा सकता है :
- 5.1.1 यह नीति परिशिष्ट क में दिए गए अनुसार लौह एवं इस्पात उत्पादों और परिशिष्ट ख में लौह एवं इस्पात उत्पादों का निर्माण करने के लिए पूंजीगत माल पर लागू है।
- 5.1.2 परिशिष्ट क में लौह एवं इस्पात उत्पादों की सूची दी गई है जिसका निर्माण अनन्य रूप से घरेलू स्तर पर किया जाना है और उसका आयात इस्पात मंत्रालय के अनुमोदन के बिना नहीं किया जा सकता है।
- 5.1.3 परिशिष्ट ख में पूंजीगत माल की एक सूची (जो विस्तृत नहीं है) दी गई है जिसके लिए खरीद संबंधी बरीयता घरेलू स्तर पर निर्मित पूंजीगत माल को दी जाएगी, यदि उनकी दी गई कीमत सदृश्य आयात किये गये पूंजीगत माल के लिए दी गई कीमत के 20 प्रतिशत के अंदर आती हो।
- 5.1.4 इस नीति का उद्देश्य सभी लौह एवं इस्पात उत्पादों को अधिसूचित करना है जिसकी खरीद सरकारी एजेंसियों द्वारा सरकारी परियोजनाओं के लिए की जाती है और न कि वाणिज्यिक पुनः बिक्री के उद्देश्य से अथवा वाणिज्यिक बिक्री के लिए उत्पादों के उत्पादन में प्रयोग करने के उद्देश्य से की गई हो।
- 5.1.5 यह नीति सरकार के मंत्रालय अथवा विभाग के द्वारा निधि प्रदत्त सभी परियोजनाओं और उनके प्रशासनिक नियंत्रण के अधीन सभी एजेंसियों/प्रतिष्ठानों पर लौह एवं इस्पात उत्पादों की खरीद के लिए लागू है।
- 5.1.6 यह नीति उन परियोजनाओं पर लागू होगी जहां लौह एवं इस्पात उत्पादों का खरीद मूल्य 25 करोड़ रुपए से अधिक होता हो। यह नीति अन्य खरीद (गैर परियोजना) के लिए भी लागू होगी जहां उस सरकारी संगठन के लिए लौह एवं इस्पात उत्पादों का वार्षिक खरीद मूल्य 25 करोड़ रुपए से अधिक होता हो।
- 5.1.7 यह नीति सरकार के मंत्रालय अथवा विभाग अथवा उनके सार्वजनिक क्षेत्र के उपक्रमों की किसी अन्य आवश्यकता को पूरा करने के लिए और/अथवा ई पी सी संविदा को पूरा करने के लिए प्राइवेट एजेंसियों द्वारा लौह एवं इस्पातों की खरीद पर लागू है।
- 5.1.8 घरेलू लौह एवं इस्पात उत्पादों के विभिन्न ग्रेडों की उपलब्धता का विश्लेषण इस नीति के अंतर्गत अधिसूचित करने से पहले करना होगा। केवल उन लौह एवं इस्पात को उत्पादों को जिनके संबंध में कम से कम एक घरेलू निर्माता मौजूद हो, अधिसूचित किया जाएगा। स्थायी समिति से परामर्श किया जा सकता है।
- 5.1.9 यह नीति यथा लागू निर्धारित गुणवत्ता मानदंडों के अनुपालन में उत्पादित परिशिष्ट ख में दिए गए लौह एवं इस्पात उत्पादों का निर्माण करने के लिए पूंजीगत माल के लिए लागू है।
- 5.1.10 लौह एवं इस्पात उत्पादों का निर्माण करने के लिए पूंजीगत मालों की घरेलू खरीद के लिए नीति लौह एवं इस्पात उत्पादों का निर्माण करने के लिए और न कि वाणिज्यिक पुनः बिक्री के उद्देश्य से पूंजीगत मालों की खरीद के वास्ते और सार्वजनिक क्षेत्र के इस्पात विनिर्माताओं और उनके प्रशासनिक नियंत्रणाधीन सभी एजेंसियों/प्रतिष्ठानों पर लागू है।
- 5.1.11 यह नीति ई पी सी संविदा और/अथवा सार्वजनिक क्षेत्र से इस्पात निर्माताओं और उनके प्रशासनिक नियंत्रण के अधीन सभी एजेंसियों/प्रतिष्ठानों की किसी अन्य आवश्यकता को पूरा करने के लिए निजी एजेंसियों द्वारा लौह एवं इस्पात उत्पादों का निर्माण करने के लिए पूंजीगत माल की खरीद पर लागू है।
- 5.1.12 सरकारी एजेंसियां जो लौह एवं इस्पात उत्पादों के निर्माण के लिए पूंजीगत माल और लौह एवं इस्पात उत्पादों की खरीद में उन स्थितियों में शामिल है जहां लौह एवं इस्पात उत्पादों का उल्लेख परिशिष्ट क और परिशिष्ट ख में नहीं किया गया हो, स्थायी समिति को निर्धारित मानदंडों के साथ इस उत्पाद के विवरण और तकनीकी विनिर्देशन उपलब्ध करायेगा। स्थायी समिति खंड 3 और खंड 4 में अधिदेश के अनुसार कार्य करेगी।

- 5.2 इस्पात मंत्रालय (एम ओ एम) परिशिष्ट क में दिए गए न्यूनतम निर्धारित घरेलू मूल्यवर्धन के साथ लौह एवं इस्पात उत्पादों को अधिसूचित करेगा।
- 5.3 लौह एवं इस्पात उत्पादों का निर्माण करने के लिए पूंजीगत माल के संबंध में नीतिगत दिशानिर्देश, परियोजना के आकार पर विचार किये बिना परिशिष्ट ख में लौह एवं इस्पात उत्पादों का निर्माण करने के लिए पूंजीगत माल की सभी खरीदों के लिए सार्वजनिक क्षेत्र के इस्पात निर्माताओं पर लागू होंगे।
- 5.4 परिशिष्ट क में लौह एवं इस्पात उत्पादों के लिए तथा परिशिष्ट ख में लौह एवं इस्पात उत्पादों का निर्माण करने के लिए पूंजीगत माल के लिए सुझाव दिए गए न्यूनतम घरेलू मूल्यवर्धन आवश्यकता घरेलू आपूर्तिकर्ता का आधार, आपूर्तिकर्ताओं की संख्या और खपत की तुलना में आयात का अनुपात जैसे कारकों के आधार पर तय किया गया है।
- 5.5 घरेलू मूल्यवर्धन आवश्यकता संबंधी मानदंडों का इस प्रकार से निर्धारण किया जाएगा जिस से कि यह किमी दिए गए समय में लौह एवं इस्पात उत्पादों के लिए घरेलू उद्योग की औसत/औसत से अधिक निर्माण क्षमता दर्शाता हो। स्थायी समिति द्वारा समय समय पर उपयुक्त रूप से इसकी समीक्षा की जाएगी और आवश्यकता पड़ने पर इस्पात मंत्रालय के अनुमोदन से इसमें संशोधन किया जाएगा।
- 6. सरकार एवं सरकारी एजेंसियों द्वारा खरीद के लिए निविदा प्रक्रिया**
- 6.1 खरीद करने वाली/सरकारी एजेंसियां डी एम आई एंड एस पी का पालन करते समय वित्त मंत्रालय और सी वी सी के अनुदेशों के अनुसार मानक खरीद संबंधी प्रक्रियाओं का पालन करेगी। यह नीति सभी निविदाओं जहां कीमत बोली नहीं खोली गई है, में इसके अधिसूचना की तिथि से लागू होगी।
- 6.2 दोनों वस्तुओं की खरीद तथा ई पी सी संविदाओं के लिए निविदा दस्तावेज में लौह एवं इस्पात उत्पादों का निर्माण करने के लिए लौह एवं इस्पात उत्पादों तथा पूंजीगत माल (जैसा कि परिशिष्ट क और परिशिष्ट ख में दर्शाया गया है, के लिए बोली लगाने वाले द्वारा न्यूनतम निर्धारित घरेलू मूल्यवर्धन का पालन करने के लिए अर्हता मानदंडों का स्पष्ट उल्लेख होना चाहिए।
- 6.3 घरेलू उत्पादों के विकास का सहयोग करने में, लौह एवं इस्पात व्यापार क्रियाकलापों में घरेलू मूल्यवर्धन का लक्ष्य निर्धारित किया गया है जिसे परिशिष्ट क और परिशिष्ट ख में दिया गया है।
- 6.4 परिशिष्ट क में लौह और इस्पात उत्पादों के खरीद की प्रक्रिया केवल उन निर्माताओं/आपूर्तिकर्ताओं के लिए ही खुली रहेगी जिसमें घरेलू मूल्यवर्धन लक्ष्यों को पूरा करने/उमसे ज्यादा पूरा करने की क्षमता हो। घरेलू मूल्यवर्धन लक्ष्यों को पूरा न करने वाले निर्माता/आपूर्तिकर्ता बोली लगाने में भाग लेने के लिए पात्र नहीं हैं।
- 6.5 परिशिष्ट ख में दी गई मदों के मामलों में, यदि खरीद करने वाली कंपनी की राय में, निविदाओं (खरीदी गई मात्रा) को 50:50 के निर्धारित अनुपात में नहीं बांटा जा सकता है, तब उनके पास मात्रा जो 50 प्रतिशत से कम नहीं हो, जो कि विभाज्य हो, के लिए पात्र घरेलू निर्माता को संविदा देने का अधिकार होगा।
- 6.6 उपर्युक्त शर्त को जारी रखते हुए, परिशिष्ट ख की मदों के लिए, यदि निविदा दी गई मद विभाज्य न हो (खरीद करने वाली कंपनी द्वारा निविदा दस्तावेज में शामिल किए जाने के लिए) यह संविदा समग्र मात्रा के लिए पात्र घरेलू निर्माता को दी जा सकती है।
- 6.7 परिशिष्ट ख के मदों के मामलों में, यदि घरेलू मूल्यवर्धन की आवश्यकताओं को पूरा करने वाले पात्र निर्माताओं में से कोई भी एल1 की बोली के अनुरूप न हो, तब एल1 की बोली धारण करने वाले मूल बोली लगाने वाला खरीद के पूर्ण मूल्य के लिए आदेश प्राप्त करेंगे।
- 6.8 वे बोली लगाने वाले जो लौह एवं इस्पात उत्पादों के घरेलू निर्माताओं के बिक्री एजेंट/अधिकृत वितरक/अधिकृत डीलर/अधिकृत आपूर्ति गृह हैं इस नीति के अंतर्गत घरेलू निर्माताओं की ओर से बोली लगाने के लिए पात्र हैं। हालांकि, यह निम्नलिखित शर्तों के अध्वधीन होगा।
- 6.8.1 बोली लगाने वाले घरेलू स्तर पर निर्मित लौह एवं इस्पात उत्पादों की बिक्री करने के लिए घरेलू निर्माता द्वारा जारी किए गए अधिकार प्रमाण पत्र प्रस्तुत करेगा।

- 6.8.2 यदि खरीद को डी एम आई एंड एम पी नीति के परिशिष्ट क के अंतर्गत शामिल किया गया हो तब बोली लगाने वाला यह घोषणा करते हुए खरीद करने वाली एजेंसी को घरेलू निर्माता द्वारा जारी किया गया स्व-प्रमाणन का शपथ पत्र प्रस्तुत करेगा कि लौह और इस्पात उत्पादों का घरेलू स्तर पर निर्माण निर्धारित घरेलू मूल्यवर्धन के मामले में किया जाता है।
- 6.8.3 यदि खरीद को डी एम आई एंड एम पी नीति के परिशिष्ट ख के अंतर्गत शामिल किया गया हो तब बोली लगाने वाला यह घोषणा करते हुए घरेलू निर्माता को सांविधिक लेखा परीक्षक द्वारा जारी किया गया प्रमाणन प्रस्तुत करेगा कि लौह और इस्पात उद्योग में उपयोग किये जाने वाले पूंजीगत माल का घरेलू स्तर पर निर्माण निर्धारित घरेलू मूल्यवर्धन के मामले में किया जाता है।
- 6.8.4 बोली लगाने वाले की यह जिम्मेदारी होगी कि वह इस नीति के अनुसार खरीद करने वाली एजेंसी को घरेलू निर्माता द्वारा जारी किये जाने के लिए अपेक्षित अन्य आवश्यक दस्तावेज प्रस्तुत करे।

7. घरेलू मूल्यवर्धन आवश्यकता

- 7.1 घरेलू रूप में निर्मित लौह और इस्पात उत्पाद अथवा पूंजीगत माल के रूप में उत्पाद के रूप में पात्र होने के लिए न्यूनतम घरेलू मूल्यवर्धन आवश्यकता का उल्लेख परिशिष्ट क और परिशिष्ट ख में किया गया है।
- 7.2 घरेलू मूल्यवर्धन निवल बिक्री कीमत (निवल घरेलू करों और शुल्कों को छोड़कर बीजक कीमत) होगी जिसमें से प्रतिशत में निवल बिक्री कीमत के एक अनुपात के रूप में भारत में निर्माण करने वाले संयंत्र में आयात की गई इनपुट सामग्री की पहुंच लागत (सभी सीमा शुल्कों को शामिल करते हुए) घटाई जाएगी।
- 7.2.1 यदि लौह और इस्पात उत्पादों को घरेलू इनपुट इस्पात (अर्ध तैयार/तैयार इस्पात) का उपयोग करके निर्माण किया जाता हो, तब खरीदी गई मात्रा और अन्य संबंधित दस्तावेजों के साथ वास्तविक घरेलू उत्पादों से खरीद का बीजक खरीद करने वाली सरकारी एजेंसी को अवश्य प्रस्तुत किया जाना चाहिए।
- 7.2.2 यदि लौह एवं इस्पात उत्पादों ने इनपुट इस्पात का आयात किया हो तब खरीदी गई मात्रा और अन्य संबंधित दस्तावेजों के साथ वास्तविक उत्पादकों से खरीदों के बीजकों को अलग से प्रस्तुत किया जाना चाहिए। घरेलू मूल्यवर्धन की सीमा निकालने के लिए, दोनों इनपुट इस्पातों (आयात किये और घरेलू) की भारित औसत पर विचार यह सुनिश्चित करने के लिए किया जाएगा कि इस नीति की न्यूनतम निर्धारित घरेलू मूल्यवर्धन आवश्यकता का पालन किया गया है।
- 7.3 यह सिफारिश की जाती है कि निविदा की प्रक्रिया में भाग लेने वाले प्रत्येक बोली लगाने वाले को नीचे दिए गए सूत्र का उपयोग करते हुए घरेलू मूल्यवर्धन की गणना करनी चाहिए ताकि यह सुनिश्चित किया जा सके कि दावा किये गये घरेलू मूल्यवर्धन इस नीति के न्यूनतम निर्धारित घरेलू मूल्यवर्धन के अनुरूप है।

लौह एवं इस्पात उत्पादों के लिए

% घरेलू मूल्यवर्धन

$$= \frac{\text{अंतिम उत्पाद की निवल बिक्री कीमत} - \text{संयंत्र में आयात किये गये लौह अथवा इस्पात की पहुंच लागत}}{\text{अंतिम उत्पाद की निवल बिक्री कीमत}} \times 100\%$$

पूंजीगत माल के लिए

% घरेलू मूल्यवर्धन

$$= \frac{\text{अंतिम उत्पाद की निवल बिक्री कीमत} - \text{संयंत्र में आयात किये गये इनपुट सामग्री की पहुंच लागत}}{\text{अंतिम उत्पाद की निवल बिक्री कीमत}} \times 100\%$$

8. प्रमाणन और लेखा परीक्षण

- 8.1 परिशिष्ट क में दिए गए उत्पादों के लिए, प्रत्येक घरेलू निर्माता यह घोषणा करते हुए खरीद करने वाली सरकारी एजेंसी को स्व-प्रमाणन का शपथ पत्र प्रस्तुत करेगा कि लौह एवं इस्पात उत्पाद का निर्धारित घरेलू मूल्यवर्धन के संबंध में घरेलू स्तर पर निर्माण किया गया है। परिशिष्ट ख के पूंजीगत माल के लिए, बोली लगाने वाला यह घोषणा करते हुए घरेलू निर्माता को सांविधिक लेखा परीक्षक द्वारा जारी किया गया प्रमाणन प्रस्तुत करेगा कि पूंजीगत माल का निर्माण घरेलू स्तर पर निर्धारित घरेलू मूल्यवर्धन के संबंध में किया गया है। वे बोली लगाने वाले जो लौह एवं इस्पात उत्पादों के घरेलू निर्माताओं का एकमात्र बिक्री एजेंट/अधिकृत वितरक/अधिकृत डीलर/अधिकृत आपूर्ति गृह हैं, ई पी सी के अंतर्गत घरेलू निर्माताओं की ओर से बोली लगाने के लिए पात्र हैं।

बोली लगाने वाला घरेलू निर्माताओं के द्वारा जारी किए गए स्व-प्रमाणन और सांविधिक लेखा परीक्षकों द्वारा जारी किये गये प्रमाणनों को यह घोषणा करते हुए खरीद करने वाली एजेंसी को प्रस्तुत करेगा कि लौह एवं इस्पात उत्पादों का घरेलू स्तर पर निर्माण निर्धारित घरेलू मूल्यवर्धन के संबंध में किया गया है। स्व-प्रमाणन का शपथ पत्र इन दिशानिर्देशों से संलग्न **प्रपत्र 1** में प्रस्तुत किया जाएगा।

- 8.2 घरेलू निर्माता की यह जिम्मेदारी होगी कि वह यह सुनिश्चित करे कि इस प्रकार से दावा किये गये उत्पादों का घरेलू स्तर पर उम उत्पाद के लिए निर्धारित घरेलू मूल्यवर्धन के संबंध में किया गया है। बोली लगाने वाले से यह भी अपेक्षित होगा कि वह घरेलू निर्माता के सांविधिक लेखा परीक्षकों द्वारा विधिवत प्रमाणित अर्धवार्षिक (मिंतंबर 30 और मार्च 31) आधार पर घरेलू मूल्यवर्धन प्रमाणपत्र उपलब्ध कराये कि पहले 6 महीनों के दौरान इस उत्पाद के लिए किये गये घरेलू मूल्यवर्धन के दावे इस नीति के अनुसार हैं। इस प्रकार के प्रमाण पत्र को संबंधित सरकारी एजेंसियों को प्रत्येक छमाही के शुरू होने के 60 दिनों के भीतर प्रस्तुत किया जाएगा और उस उत्पादों की आपूर्ति को पूरा करने तक प्रस्तुत करता रहेगा।
- 8.3 खरीद करने वाली एजेंसी बोली लगाने वाले द्वारा प्रस्तुत किये गये इस्पात उत्पाद में घरेलू मूल्यवर्धन के संबंध में स्व-प्रमाणन का शपथ पत्र स्वीकार करेगा। सामान्य तौर पर खरीद करने वाली एजेंसी की यह जिम्मेदारी होगी कि वह इस दावे की सत्यता की जांच करे। इसकी सत्यता प्रदर्शित करने की जिम्मेदारी बोली लगाने वाले की होगी जब उसे ऐसा करने के लिए कहा जाए।
- 8.4 यदि खरीद करने वाली एजेंसी अथवा संबंधित सरकारी एजेंसी द्वारा लौह एवं इस्पात उत्पादों में घरेलू मूल्यवर्धन के संबंध में बोली लगाने वाले के दावे के विरुद्ध कोई शिकायत प्राप्त होती है तब खरीद करने वाली एजेंसी के पास सभी संबंधित दस्तावेजों का निरीक्षण करने और उसकी जांच करने तथा निर्णय लेने का पूर्ण अधिकार होगा। यदि कोई स्पष्टीकरण की आवश्यकता होती है तब मामले को तकनीकी सहायता के लिए अनुरोध के साथ इस्पात मंत्रालय को भेजा जा सकता है।
- 8.5 सरकारी एजेंसी को भेजे गए किसी शिकायत का निपटारा सभी आवश्यक दस्तावेजों को प्रस्तुत करने के साथ इसे भेजे जाने के 4 सप्ताह के भीतर किया जाएगा। बोली लगाने वाले से यह अपेक्षित होगा कि वह शिकायत दायर करने के 2 सप्ताह के भीतर सरकारी एजेंसी को लौह एवं इस्पात उत्पादों में दावा किये गये घरेलू मूल्यवर्धन के समर्थन में आवश्यक दस्तावेज प्रस्तुत करे।
- 8.6 यदि इस मामले को इस्पात मंत्रालय के पास भेजा जाता है तब इस्पात मंत्रालय के अधीन गठित शिकायत निवारण समिति सरकारी एजेंसी के दृष्टिकोण पर विचार करने के बाद बोली लगाने वाले से सभी दस्तावेजों के प्राप्त होने और उसका संदर्भ भेजे जाने के 4 सप्ताह के भीतर शिकायत का निपटारा करेगी। बोली लगाने वाले से यह अपेक्षित होगा कि वे इस मामले के संदर्भ के 2 सप्ताह के भीतर इस्पात मंत्रालय के अंतर्गत शिकायत निवारण समिति को लौह एवं इस्पात उत्पादों में दावा किए गए घरेलू मूल्यवर्धन के समर्थन में आवश्यक दस्तावेज प्रस्तुत करे। यदि बोली लगाने वाले द्वारा कोई सूचना प्रस्तुत नहीं की जाती है तब शिकायत निवारण समिति दावे की प्रमाणिकता अधिक करने के लिए सरकारी एजेंसी के परामर्श से आगे आवश्यक कार्रवाई कर सकती है।
- 8.7 घरेलू मूल्यवर्धन की निर्धारित सीमा का आकलन करने की लागत का वहन खरीद करने वाली एजेंसी द्वारा किया जाएगा यदि घरेलू मूल्यवर्धन प्रमाण पत्र के अनुसार सही पाया गया हो। हालांकि, यदि ऐसा पाया गया हो कि दावा किए गए अनुसार घरेलू मूल्यवर्धन सही नहीं है तब आकलन की लागत बोली लगाने वाले द्वारा भुगतान के योग्य होगी जिन्होंने एक गलत प्रमाण पत्र प्रस्तुत किया है। इसे लागू करने के तरीके को निविदा दस्तावेज में परिभाषित किया जाएगा।

9. प्रतिबंध

- 9.1 प्रत्येक सरकारी एजेंसी निविदा दस्तावेज में निर्धारित घरेलू मूल्यवर्धन का बोली लगाने वाले के द्वारा गलत घोषणा किए जाने की स्थिति में दण्ड को स्पष्ट रूप से परिभाषित करेगा। इस दण्ड में ऐसे निर्माता/सेवा प्रदाता की ई एम डी को जब्त करना, अन्य वित्तीय दंड लगाना और उसे काली सूची में डालना शामिल हो सकता है।
- 9.2 संबंधित बोली लगाने वाले के द्वारा इस्पात मंत्रालय को किसी प्रकार की शिकायत भेजे जाने की स्थिति में, 10 लाख रुपए अथवा खरीदी जा रही डी एम आई एंड एस पी के मूल्य का 0.2 प्रतिशत (अधिकतम 20 लाख के अध्येधीन) इसमें से जो भी अधिक हो, का शिकायत शुल्क होगा जिसका भुगतान शिकायतकर्ता द्वारा शिकायत के साथ इस्पात मंत्रालय के अधीन शिकायत निवारण समिति के पास जमा किए गए डिमाण्ड ड्राफ्ट के द्वारा किया जाएगा। यदि, शिकायत को सही नहीं पाया जाता है तब सरकारी एजेंसी के पास उक्त राशि को जब्त करने का अधिकार सुरक्षित है। यदि शिकायत पर्याप्त रूप से सही पाई जाती है तब शिकायतकर्ता द्वारा जमा किए गए शुल्क को बिना किसी ब्याज के वापिस किया जाएगा।

10. इस्पात मंत्रालय द्वारा कार्यान्वयन की मॉनीटरिंग

- 10.1 इस नीति के प्रावधान प्रकाशन की तिथि से 5 वर्षों की अवधि के लिए लागू रहेंगे। इस नीति की अवधि को इस्पात मंत्रालय के विवेक से और आगे बढ़ाया जा सकता है।
- 10.2 इस्पात मंत्रालय इस नीति के कार्यान्वयन की मानीटरिंग करने के लिए नोडल मंत्रालय होगा।
- 10.3 डी एम आई एंड एम पी नीति के अंतर्गत सभी लागू एजेंसियां इस नीति का कार्यान्वयन मुनिश्चित करेंगी और वार्षिक रूप से जून के महीने में एक घोषणा भेजेगी जिसमें इस नीति के अनुपालन की सीमा और पिछले वित्तीय वर्ष के दौरान उसके अनुपालन न किए जाने के कारणों को दर्शाया जाएगा।

इस्पात मंत्रालय को संदर्भ

किमी ऐसे प्रश्न की स्थिति में कि क्या खरीदी जा रही मद इस नीति के अंतर्गत शामिल किए जाने वाले डी एम आई एंड एम पी है, इस मामले को स्पष्टीकरण के लिए इस्पात मंत्रालय के पास भेजा जाएगा।

परिशिष्ट क - धरेलू स्तर पर निर्मित उत्पादों के लिए अनन्य

क्र. सं.	लौह एवं इस्पात उत्पादों की सांकेतिक सूची	लागू एच एस कोड	न्यूनतम धरेलू मूल्यवर्धन आवश्यकता
1	600 मि. मी. अथवा उससे अधिक की चौड़ाई वाले लौह अथवा गैर एलॉय इस्पात का फ्लेट रोल उत्पाद, हॉट रोलड, न ढका हुआ, प्लेट लगाया हुआ अथवा कोट किया हुआ	7208	50%
2	600 मि. मी. अथवा उससे अधिक की चौड़ाई वाले लौह अथवा गैर एलॉय इस्पात का फ्लेट रोल उत्पाद, कोल्ड रोलड (कोल्ड - कम किया हुआ), न ढका हुआ, प्लेट लगाया हुआ अथवा कोट किया हुआ	7209	50%
3	600 मि. मी. अथवा उससे अधिक की चौड़ाई वाले लौह अथवा गैर एलॉय इस्पात का फ्लेट रोल उत्पाद, ढका हुआ, प्लेट लगाया हुआ अथवा कोट किया हुआ	7210	50%
4	600 मि. मी. से कम की चौड़ाई वाले लौह अथवा गैर एलॉय इस्पात का फ्लेट रोल उत्पाद, न ढका हुआ, प्लेट लगाया हुआ अथवा कोट किया हुआ	7211	35%
5	600 मि. मी. से कम की चौड़ाई का लौह अथवा गैर एलॉय इस्पात का फ्लेट रोल उत्पाद, ढका हुआ, प्लेट लगाया हुआ अथवा कोट किया हुआ	7212	35%
6	लौह एवं गैर एलॉय इस्पात का अनियमित रूप से षंठा हुआ क्वाडल में बार्स और रॉड, हॉट रोलड	7213	35%
7	लौह अथवा गैर एलॉय इस्पात के अन्य बार्स और रॉड्स जिसे फोर्ज किए जाने की तुलना में आगे अधिक वर्क नहीं किया हुआ, हॉट रोलड, हॉट ड्रॉन अथवा हॉट एक्सट्रूडेड परंतु रोलिंग के बाद उसे टिबिस्ट किये जाने सहित	7214	35%
8	लौह अथवा गैर एलॉय इस्पात का अन्य बार्स एंड रोड्स	7215	35%
9	लौह अथवा गैर एलॉय इस्पात का एंगल, शेप और सेक्शनस	7216	35%
10	लौह अथवा गैर एलॉय इस्पात का तार	7217	50%
11	600 मि. मी. अथवा उससे अधिक की चौड़ाई का स्टेनलैस इस्पात का फ्लेट रोलड इस्पात	7219	50%
12	600 मि. मी. से कम की चौड़ाई का स्टेनलैस इस्पात का फ्लेट रोलड इस्पात	7220	50%
13	स्टेनलैस स्टील का अन्य बार्स और रोड्स; स्टेनलैस स्टील का एंगल शेप और सेक्शनस	7222	50%
14	अन्य एलॉय इस्पात का तार	7229	35%
15	लौह अथवा इस्पात को रेल, रेलवे अथवा ट्रामवे ट्रेक निर्माण सामग्री	7302	50%

16	कास्ट लौह का ढूब, पाइप और होलो पाइप	7303	35%
17	लौह (कास्ट आयरन को छोड़कर) अथवा इस्पात का ढूब पाइप और होलो प्रोफाइल, मीमलैस	7304	35%
18	लौह अथवा इस्पात का सर्कुलर क्रॉस सेक्शन वाले अन्य ढूब और पाइप (उदाहरण के लिए, वेल्ड किया हुआ, रिबेट किया हुआ अथवा समान रूप से बंद किया गया हुआ), जिमकी बाहरी त्रिज्या 406.4 मि. मी. से अधिक हो	7305	35%
19	लौह अथवा इस्पात के अन्य ढूब, पाइप और होलो प्रोफाइल (उदाहरण के लिए ओपन मीन अथवा वेल्ड किया हुआ, रिबेट किया हुआ अथवा समान रूप से बंद किया गया हुआ)	7306	35%
20	लौह अथवा इस्पात का ढूब अथवा पाइप फिटिंग (उदाहरण के लिए, कनेक्टर/कप्लिंग, एल्बो स्लीव्स)	7307	35%
21	स्टेनलैस स्टील का अनियमित रूप से ँंठा हुआ क्वाइल में बार्स और रॉड, हॉट रोल्ड	7221	35%
22	स्टेनलैस स्टील का वायर	7223	35%
23	इलेक्ट्रिकल स्टील सहित 600 मि. मी. अथवा उससे अधिक की चौड़ाई वाले अन्य एलॉय स्टील का फ्लेट रोल्ड इस्पात	7225	35%
24	इलेक्ट्रिकल स्टील सहित 600 मि. मी. से कम की चौड़ाई वाले अन्य एलॉय स्टील का फ्लेट रोल्ड इस्पात	7226	35%
25	अन्य एलॉय स्टील का अनियमित रूप से ँंठा हुआ क्वाइल में बार्स और रोड, हॉट रोल्ड	7227	15%
26	अन्य एलॉय स्टील का अन्य बार्स और रोड्स; अन्य एलॉय स्टील का एंगल, शेप्स और सेक्शन्स; एलॉय अथवा नॉन एलॉय स्टील का होलो ड्रिल बार्स और रोड्स	7228	35%
27	लौह अथवा इस्पात की शीट पाइलिंग, चाहे ड्रिल किया हुआ हो अथवा नहीं, चाहे पंच किया हुआ हो अथवा नहीं, चाहे असेम्बल किये हुए तत्वों से बना हुआ हो अथवा नहीं; लौह अथवा इस्पात का वेल्ड किया हुआ एंगल, शेप और सेक्शन्स	7301	15%
28	स्ट्रक्चर्स (9406 के शीर्ष का प्रीफैब्रिकेटेड भवनों को छोड़कर) और स्ट्रक्चर्स का हिस्सा	7308	15%
29	300 लीटर से अधिक क्षमता का लौह अथवा इस्पात का किसी सामग्री (कम्प्रेस किए हुए अथवा सरलीकृत गैस को छोड़कर) के लिए भंडार, टैंक, वैट और समान कन्टेनर चाहे उसे लाइन किया गया हो अथवा नहीं या उसे हीट से इन्सुलेट किया गया हो अथवा नहीं लेकिन यांत्रिक अथवा तापीय उपक्रम से युक्त न हो	7309	15%
30	अधिकतम 300 लीटर की क्षमता का लौह अथवा इस्पात का किसी सामग्री (कम्प्रेस किए हुए अथवा सरलीकृत गैस को छोड़कर) के लिए टैंक, कास्ट, ड्रम, केन, बॉक्स और समान कन्टेनर चाहे उसे लाइन किया गया हो अथवा नहीं या उसे हीट से इन्सुलेट किया गया हो अथवा नहीं लेकिन यांत्रिक अथवा तापीय उपक्रम से युक्त न हो	7310	15%
31	लौह अथवा इस्पात का कम्प्रेस किया हुआ अथवा सरलीकृत गैस के लिए कन्टेनर	7311	15%
32	लौह अथवा इस्पात का स्टेंडिड वायर, रोप, केबल, प्लेटिड बैंड, स्लिंग और उसके समान वस्तु जिसे त्रिचूतीय रूप से इन्सुलेट न किया गया	7312	15%
33	लौह अथवा इस्पात का फेनसिंग के लिए उपयोग किये जाने वाला बार किया हुआ वायर; ट्रिवस्ट किया हुआ हूप अथवा सिंगल प्लेट वायर, बार्स किया हुआ अथवा नहीं और लूज तरीके से ट्रिवस्ट किया हुआ डबल वायर	7313	15%
34	लौह अथवा इस्पात तार का ड्रिल, नेटिंग और फेनसिंग; लौह अथवा इस्पात का विस्तार किया हुआ धातु	7314	15%

35	लौह अथवा इस्पात का चैन और उसका हिस्सा	7315	15%
36	लौह अथवा इस्पात का टैंकर, ग्रेपनेल्म और उसका हिस्सा	7316	15%
37	लौह एवं इस्पात की वस्तुएं	7317	15%
38	लौह एवं इस्पात की वस्तुएं	7318	15%
39	लौह एवं इस्पात की वस्तुएं	7319	15%
40	लौह अथवा इस्पात का स्प्रिंग और स्प्रिंग के लिए लीन्स	7320	15%
41	लौह अथवा इस्पात का स्टोव्स, रेंज, ग्रेड, कूकर (केंद्रीय हिटिंग के लिए सहायक बायलरों के साथ उन वस्तुओं सहित), वारवेक्यूज, ब्रेजियर्स, गैस रिंग, प्लेट वामर्स और समान गैर-विद्युतीय घरेलू उपकरण और उसका हिस्सा	7321	15%
42	लौह अथवा इस्पात का केंद्रीय हिटिंग के लिए रेडियेटर जिसे विद्युतीय रूप से हीट न किया गया हो और उसका हिस्सा; लौह अथवा इस्पात का हेयर हीटर और हॉट एयर वितरक जिसे विद्युतीय रूप से हीट न किया गया हो, फेन अथवा ब्लोअर जो मोटर से चलती हो और उसके हिस्से को शामिल करते हुए	7322	15%
43	लौह अथवा इस्पात का टेबल और समान घरेलू वस्तुएं और उसका हिस्सा	7323	15%
44	लौह अथवा इस्पात का सेनेटरी वेयर और उसको पार्ट्स	7324	15%
45	लौह अथवा इस्पात का अन्य कास्ट सामान	7325	15%
46	लौह अथवा इस्पात का विद्युतीय इस्पात और अन्य वस्तु	7326	15%
47	रेलवे अथवा ट्रामवे पेसेंजर कोच जो स्वयं आगे नहीं बढ़ता हो	8605	50%
48	रेलवे अथवा ट्रामवे माल वेन और वेगेन जो स्वयं आगे नहीं बढ़ता हो	8606	50%
49	रेलवे अथवा ट्रामवे लोकोमोटिव का हिस्सा अथवा रोलिंग स्टॉक जैसे बोगिज, बिसल बोगिज, एक्सेल और फोज्ड किया हुआ पहिया और उसका हिस्सा	8607	50%

विवरणों में शामिल किए गए उत्पाद सांकेतिक हैं, विनिर्दिष्ट एच एम कोड के अंतर्गत सभी उत्पादों को परिशिष्ट के भाग के रूप में शामिल किया गया है।

परिशिष्ट ख

लौह और इस्पात उत्पादों का निर्माण करने के लिए पूंजीगत माल की सांकेतिक सूची (जो विस्तृत नहीं है)

क्र. सं.	संयंत्र शॉप	पूंजीगत माल	न्यूनतम घरेलू मूल्यवर्धन आवश्यकता
1	कच्चा माल संभाल प्रणाली	चूर्ण की हुई सामग्री के लिए एप्रोन फीडर, बेरल कप्लिंग, हैवी ड्यूटी वियेरिंग, हाइड्रोलिक डिक्स ब्रेक्स, टैंकर एंड कंटेनर, पाइप कंवेयर के लिए कंवेयर बेल्ट, हार्ड एंगल कंवेयर प्रणाली, क्रशर्स, क्रेन रेल लुब्रिकेशन, चार गरडर ग्राइडर ई ओ टी क्रेन, क्रेन वेइंग प्रणाली, क्रेन एयर कंडीशनिंग, फ्यूड कप्लिंग, 4 लिफ्ट ट्रक्स, हाइड्रोलिक मोटर्स, हाइड्रोलिक सिस्टम, लॉकिंग एसेम्बली (फ्रिक्शन ग्रिप), लोड सेल्स, लेवल सेन्सर्स, पाइप कंवेयर प्रणाली, प्लग/पाडेल फीडर, न्यूमेटिक हुलाई - धना एवं लिन फेस, रिक्लेमर्स, रेडियो रिमोट कंट्रोल, रेल फिक्सिंग व्यवस्था (विशेष), रेपिड/फ्लेड लोडिंग प्रणाली, स्टेर्स, स्पेशल स्क्रीन, स्लिव रिंग वियेरिंग, ट्रिप्लर्स, ट्रांसफर कार, टॉर्स (स्पेशल), वाइब्रेशन, आइसोलेशन प्रणाली (स्प्रिंग डम्पर) वेगन टिप्लर्स, वेगन लोडर	50%
2	मिनिरल बेनिफिकेशन (लौह अयस्क और कोयला) उपकरण	इंडस्ट्रीयल क्रशर्स, ग्राइनिंग मिल, परम्परागत स्क्रीन, स्लूरी पम्पस, हिरेट थिकनर्स, फिल्टर्स, हाइड्रोक्लोन्स	50%

3	कोक अवेन	कोक ओवन मिलिका रिफेक्टरी, एन्क्रेज सिस्टम, ब्रंच तरडन के साथ वेस्ट गैस वाल, फ्लेस प्लेट, डोर फ्रेम, डोर बॉडी, माइनर कास्टिंग: गुजनेक, बाल बॉक्स, ए पी लिड, चार्जिंग और इन्स्पेक्शन होल लिड एंड फ्रेम रिचर्सिंग मंकेनिजम, केंद्रीकृत लूत्रिकेशन प्रणाली हाइड्रोजेट डोर क्लीनिंग तंत्र, कोड कंवेयर सिस्टम, स्क्रिप होइस्ट, डोर लोवरिंग रैक, आइसोलेशन/रिचर्सिंग कॉक्स, II ऑटोमेशन, अवेन मशीन	50%
4	उप-उत्पाद संयंत्र	प्राथमिक गैस कूलर, इलेक्ट्रोस्टैटिक तार प्रेसिपिटेटर, H ₂ S, NH ₃ और नपथलिन स्कूब्वर, कोम्बी स्ट्रीप्पर, फ्लेशिंग लिक्व पम्प, क्लास किन, क्लाक रियेक्टर, वेस्ट हीट बायलर, डिक्लेटर्स	50%
5	सिंटर संयंत्र उपकरण	पेलेट कार, ड्राइव/डिस्चार्ज इंड स्पोकेट एंसेम्बली कब्ड रेल, स्लाइड रेल, हॉट सिंटर ब्रेकर और गिजली, डिप रेल एंड रनिंग रेल, प्रोसेस फेन के लिए इम्पेलर एंसेम्बली, सिंटर मशीन का ड्राइव एंसेम्बली, उच्च तीव्रता वाला मिक्सर और नोडूलाइजर	50%
6	पेलेट संयंत्र उपकरण	पेलेट कार, ड्राइव/डिस्चार्ज इंड स्पोकेट एंसेम्बली कब्ड रेल, स्लाइड रेल, रनिंग रेल बरटिकल रोलर मिल, प्रोसेस फेन के लिए इम्पेलर एंसेम्बली, इनडूरेटिंग मशीन का ड्राइव एंसेम्बली, उच्च तीव्रता वाला मिक्सर, बालिंग डिक्स, सिंगल डेक्स रोलर स्क्रीन एंड डबल डेक्स रोलर स्क्रीन	50%
7	ब्लास्ट फरनेस उपकरण	ब्लेडर बाल के साथ बेल रहित टॉप प्रणाली, एस जी आयरन स्टेव कूलर, कोपर स्टेव कूलर, स्टॉक लेवल इंडिकेटर (रडार टाइप), मड गन, ड्रिलिंग मशीन एंड मेनिपुलेटर, गैस किल्लिंग प्लांट प्रणाली, इसके बाइस-पास वाल सहित टॉप रिक्वरी टूबाइन सिस्टम, डि-ब्रिक्किंग मशीन, रि-रेलिंग उपकरण, पी सी आई प्रणाली, पी सी आई के लिए ग्राइंडिंग मिल, स्टॉक लेवल इंडिकेटर, टूयेरे स्टाक एंसेम्बली, वेस्ट हीट रिक्वरी प्रणाली, बी एफ एवं हॉट ब्लास्ट स्टोव प्रौद्योगिकीय वाल, एन्व ब्रंडन प्रोब्स, स्लग ग्रेन्यूलेशन यूनिट, टूयेरे एंड टूयेरे कूलर, टोरपेडो लेडल कार, बी एफ हरथ रिफेक्ट्री	50%
8	डायरेक्ट रिडक्शन प्लांट उपकरण	चार्ज डिस्ट्रीब्यूटर, अपर एंड लोअर सील लेग, रिफोमर एंड रि-क्यूरेटर सिस्टम, बर्डन फिडर्स, टूबो-एक्सपेंडर, प्रोसेस गैस कम्प्रेसर, सील गैस कम्प्रेसर एवं बोटम सील गैस कम्प्रेसर, सील गैस जेनरेटर एवं डायर्स, प्रोसेस गैस हीटर, CO ₂ रिमूवल प्लांट	50%
9	वेमिक ऑक्सीजन फर्नेस उपकरण	मुख्य और अनुरक्षण उपकरण जिसमें कंवेटर, गनिंग मशीन, रिफेक्ट्री/स्लग मॉनीटरिंग उपकरण, कंवेटर वेसेल, ट्रनिअन रिंग एंड सम्पेशन प्रणाली, ट्रनिअन बियरिंग और हाउसिंग, कंवेटर बुल गियर यूनिट और टिल्ट ड्राइव सिस्टम, कंवेटर के रोटेरी ज्वाइंट, बोटम स्ट्रिंग सिस्टम, क्लपिंग के साथ लांस बाडी, लांस कोपर टिप्स, ऑक्सीजन ब्लोबिंग/बोटम स्टीरिंग के लिए बाल स्टेशन, सब-लान सिस्टम, प्रोसेस मॉड्यूल अर्थात् प्रोसेस साफ्टवेयर/हार्डवेयर के साथ ऑफ गैस एनेलाइजर, कंटेनर लैब मेजरमेंट प्रोब, स्विच ओवर स्टेशन, प्राइमरी गैस के लिए आई डी फेन, हॉट मेटल और स्टील लेडल, लेडल ट्रांसफर कार, लेडल अनुरक्षण उपकरण, स्लेग पोट, स्लग पोट ट्रांसफर कार, स्क्रैप बॉक्स क्रेप ट्रांसफर कार, लांस करेज, लांस गाइड, क्रेन एंड हाइस्ट, लांस होइस्ट एंड ट्राली, लांस टिल्टिंग उपकरण, लांस को लिफ्ट करने के लिए ट्रेवस, विभिन्न आकर के बंकर, बिन बाइब्रेटर, वेइंग हूपर, अनुरक्षण स्टेण्ड, डी इस्टिंग सक्शन हूड, टीमिंग/एच एम, लेडल रिलाइनिंग स्टैंड, स्टैंड कूलिंग स्टेक इन्स्पेक्शन उपकरण, हूड ट्रेवर्स करेज, रिफेक्ट्री, बाइपास एवं आइसोलेशन वाल्व, फ्लेयर स्टेक एवं इगनिवेशन सिस्टम, स्क्रबिंग टोवर सेल - चेट गैस क्लीनिंग सिस्टम, डॉंग हाउस लेडल डायर, लेडल	50%

		प्री-हीटर, लेडल कूलर, फ्यूम कोलेक्शन हूड्स, क्लीन गैस स्टेक, डस्ट सिलो, वेग ब्रिज, स्लग रिट्रैनिंग उपकरण	
10	इलेक्ट्रिक आर्क फर्नेस	फर्नेस प्रोपर (जिसमें फर्नेस लोवर सेल, अपर सेल और रूफ, टिल्टिंग प्लेटफार्म, फर्नेस गेन्ट्री शामिल है) और ट्रांसफार्मर, इलेक्ट्रोड रेगुलेशन प्रणाली, हाइड्रोलिक सिस्टम, रिफैक्ट्री, लेवल I एंड II आटोमेशन सिस्टम के पार्ट्स। एल एफ - वाटर कूल्ड लेडल रूफ, इलेक्ट्रोड मास्ट एंड आमर्स, इलेक्ट्रोड रेगुलेशन सिस्टम, वायर फिडिंग सिस्टम, बोटम इनडरट गैस स्टिरिंग बाल सिस्टम पोरुस प्लग और टॉप लांस के लिए, इमरजेंसी लांसतंत्र, ड्राइव यूनिट के साथ लांस केरेजि सिस्टम, स्वचालित तापक्रम, सेम्पलिंग और बाथ लेबल/ओ2 मेजरमेंट, तापक्रम और आक्सीजन इम्मजन लांस, ड्राइव यूनिट के साथ लांस केरेज सिस्टम, हाइड्रोलिक सिस्टम, रिफैक्ट्री, लेडल रूफ डेल्टा पोरशन, आर एच प्रोपर (जिसमें लेडल ट्रांसफर कार, बेक्यूम वेमेल, वेमेल लिफ्टिंग और लोवरिंग सिस्टम शामिल है, हाइड्रोलिंग सिस्टम, मल्टी फंक्शन लांस, वाल्व रेक्स/स्टेशन, इलेक्ट्रोड क्लेप यूनिट, इलेक्ट्रोड आमर्स का कंडक्टर, वाटर कूल्ड केबल, ए आर स्टेरिंग वाल्व रेक, लांस ट्रांसपोर्ट कार, रिफैक्ट्री लांस, हाइड्रोलिक सिलेंडर, लेडल रूफ लिफ्टिंग सिलेंडर, लूत्रिकेशन प्रणाली, सक्शन हूड, डम्पर, वाइब्रो फीडर, वेडंग होपर, वायर फिडिंग प्रणाली, इलेक्ट्रोड निपिलिंग स्टेड, क्रेन, होइस्ट, तापमान और सेम्पलिंग टिप्स, लेडल स्टैंड, ई एस पी, डिडिक्टिंग हूड, रिफैक्ट्री, वेग फिल्टर, क्रेन इत्यादि।	50%
11	सतत कास्टिंग उपकरण	लाइले टरेट, लेडल कवर मेनिपुलेटर, लेडल शारउड मेनिपुलेटर, टनडिस कार, कंटिन्यूअस टनडिस टेम्पेचर मेजरमेंट सिस्टम, टनडिस स्टोपर रूड मेकेनिजम, इमरजेंसी कट-आफ गेट, मोल्ड एसेम्बली, नोजल क्लिक चेंज डिवाइस, मोल्ड ओसीलेटर एंड ई एम एस सिस्टम, इलेक्ट्रो-मेगेनेटिक ब्रेकिंग सिस्टम, स्ट्रेड गाइड सेगमेंट, विदड्रावल एंड स्ट्रेघटेनिंग यूनिट (डब्ल्यू एस यू), रोल गेप चेकर इमरजेंसी टार्च कटर, टार्च कटिंग मशीन, डेब्रर, मार्किंग मशीन, टेकेनोलोजी कंट्रोल सिस्टम एंड प्रोसेस मोडल, ब्लेक रिफैक्ट्रीज, स्ट्रेड गन्डे सेगमेंट, टनडिश, लाइले कवर, रोलर टेबल एंड आक्सीलिरीज, माल्ड एंड सेगमेंट मेनटेनेस इक्यूपमेंट टनडिस मेनटेनेस इक्यूपमेंट, ई एम बी आर सिस्टम	50%
12	प्लेट मिल	लार्ज कास्टिंग एंड फाजिग लाइक मिल हाउसिंग, बेड प्लेट्स वर्क्स रोल, बेकअप रोल, इंड स्पिडल्स; रोलर टेबल, बेकअप रोल एंड वर्क रोल चक्स क्वाडलर/टेनशन रिल/अनक्वाइलर, ए जी सी सिलेंडर, शेयर्स, लेवेलेर्स, लाजेर वेल्डर, पेकेजिंग मशीन, नॉन कान्टेक्ट, गेज/प्रोफाइल गेज, एंटी-फ्रिक्शन रोल नेक बियरिंग, आयल फिल्म बियरिंग, गियर बॉक्स, मिल मोटर्स	50%
13	लॉग मिल	मिलम हाउसिंग, बेड प्लेट, वर्क रोल, बेकअप रोल, स्पिनडेल्स; रोलर टेबल, कॉयलर /टेंशन रिल /अनकॉयलर, शेयर्स, बिल्डट वेल्डर, पेकेजिंग मशीन, नान-कान्टेक्ट गॉज/प्रोफाइल गॉज, एंटी-फ्रिक्शन रोल नेक बियरिंग, आयल फिल्म बियरिंग, फिनिशिंग ब्लाक्स, गियर बॉक्स, मिल मोटर	50%

* परिशिष्ट ख में मर्दे निर्माण करने वाले इस्पात के लिए पूंजीगत सामानों की एक सांकेतिक सूची है। यह सूची विस्तृत नहीं है। इस्पात के निर्माण के लिए सभी पूंजीगत मालों पर 50% की न्यूनतम घरेलू मूल्यवर्धन आवश्यकता के साथ इस नीति के अंतर्गत खरीद बरीयता के लिए विचार किया जाएगा।

फार्म - 1

100/- रुपए के स्टाम्प पेपर पर दिए जाने के लिए लौह एवं इस्पात उत्पादों/पूँजीगत मालों में घरेलू मूल्यवर्धन के संबंध में स्व-प्रमाणन शपथ के लिए प्रपत्र :

मैं _____ सुपुत्र, सुपुत्री, पत्नी, _____ का निवासी _____
एतद् द्वारा निष्ठापूर्वक नीचे दिए गए अनुसार वचन देता हूँ और घोषण करता हूँ :

कि मैं अधिसूचना सं. : _____ के माध्यम से जारी किए गए भारत सरकार की नीति के नियम और शर्तों का पालन करने के लिए सहमत होऊंगा।

कि यहां नीचे दी गई सूचना मेरे सर्वोत्तम ज्ञान और विश्वास के अनुसार सही है और मैं घरेलू मूल्यवर्धन का आकलन करने के प्रयोजन से खरीद करने वाली एजेंसी के समक्ष संगत रिकार्ड प्रस्तुत करने का वचन देता हूँ।

कि सभी इनपुट्स के लिए घरेलू मूल्यवर्धन जिसमें उक्त लौह एवं इस्पात उत्पाद शामिल हैं का सत्यापन मेरे द्वारा कर लिया गया है और मैं उसमें किये गये दावों की सत्यता के लिए जिम्मेदार हूँ।

कि इसमें उल्लिखित उत्पाद घरेलू मूल्यवर्धन सही नहीं पाये जाने और मूल्यवर्धन के लिए निर्धारित मानदंडों को पूरा नहीं किये जाने की स्थिति में, घरेलू मूल्यवर्धन का आकलन करने के उद्देश्य से खरीद करने वाली एजेंसी के आकलन के आधार पर मैं 36 महीनों की अवधि के लिए किसी सरकारी निविदा से अयोग्य ठहराया जाऊंगा। इसके अलावा मैं इस प्रकार के आकलन की सभी लागतों का वहन करूंगा।

कि मैंने अधिसूचना संख्या _____ जिसमें सरकारी खरीद में घरेलू स्तर पर निर्मित लौह एवं इस्पात उत्पादों को बरीयता दी गई है, में संदर्भित सभी शर्तों का पालन किया है और यह कि खरीद करने वाली एजेंसी को एतद् द्वारा अधिकार दिया जाता है कि वह मेरे ई एम डी को जप्त करे। मैं यह भी वचन देता हूँ कि आकलन की लागत का भुगतान करूंगा और निविदा दस्तावेज में यथा उल्लिखित सभी दण्ड राशि का भुगतान करूंगा।

मैं 8 वर्षों की अवधि के लिए कम्पनी के रिकॉर्ड में निम्नलिखित सूचना रखने के लिए सहमत हूँ और किसी सांविधिक प्राधिकारी को सत्यापन के लिए इसे उपलब्ध कराऊंगा।

- i. बोली लगाने वाले का नाम और ब्यौरा (पंजीकृत कार्यालय, विनिर्माण इकाई का स्थान, कानूनी प्रतिष्ठान की प्रकृति)
- ii. वह तिथि जब यह प्रमाण पत्र जारी किया गया है।
- iii. लौह एवं इस्पात उत्पाद जिसके लिए इस प्रमाण पत्र को प्रस्तुत किया जाता है।
- iv. खरीद करने वाली एजेंसी जिसे यह प्रमाण पत्र प्रस्तुत किया जाता है।
- v. दावा की गई घरेलू मूल्यवर्धन की प्रतिशतता और क्या यह निर्धारित घरेलू मूल्यवर्धन के आरंभिक मूल्य को पूरा करता है।
- vi. विनिर्माता की इकाई का नाम और संपर्क विवरण
- vii. लौह और इस्पात उत्पादों की निवल बिक्री कीमत
- viii. संयंत्र तक भाड़ा, बीमा और रखरखाव
- ix. लौह एवं इस्पात उत्पादों का निर्माण करने के लिए उपयोग की जाने वाली इनपुट इस्पात (आयात किया गया) की सूची और कुल लागत मूल्य।
- x. इनपुट इस्पात जिसकी आपूर्ति घरेलू स्तर पर की जाती है की सूची और कुल लागत
- xi. कृपया यदि इनपुट इन हाऊस नहीं हो तब आपूर्तिकर्ताओं से प्राप्त घरेलू मूल्यवर्धन प्रमाणपत्र संलग्न करें।
- xii. आयात किये गये इनपुट इस्पात के लिए, सी आई एफ मूल्य, शुल्क और करों, पोर्ट पर उतारने से संबंधित प्रभारों और अंतर्देशीय भाड़े की लागत के ब्यौरे के साथ भारतीय पोर्ट पर पहुंच कीमत।

(प्रतिष्ठान/कंपनी का नाम) के लिए और उसकी ओर से

अधिकृत हस्ताक्षरकर्ता (निदेशक बोर्ड द्वारा विधिवत अधिकृत किये जाने के लिए)

<नाम, पदनाम और संपर्क सं. की प्रविष्टि करें>

MINISTRY OF STEEL

NOTIFICATION

New Delhi, the 29th May, 2019

G.S.R. 385(E).—The revised Policy for providing preference to domestically manufactured Iron & Steel Products in Government procurement is hereby published for general information.

[F. No.3(2)/2018-IDD]

RASIKA CHAUBE, Addl. Secy.

POLICY FOR PROVIDING PREFERENCE TO DOMESTICALLY MANUFACTURED IRON & STEEL PRODUCTS IN GOVERNMENT PROCUREMENT- REVISED, 2019

1 Background

- 1.1 This policy provides preference to Domestically Manufactured Iron and Steel Products (DMI&SP) in Government procurement.
- 1.2 The policy is applicable to iron & steel products as provided in Appendix A and capital goods for manufacturing iron & steel products in Appendix B, produced in compliance to prescribed quality standards, as applicable.
- 1.3 The policy is applicable to every Ministry or Department of Government and all agencies/entities under their administrative control and to projects funded by these agencies for purchase of iron & steel products for government projects. However, this policy shall not apply for purchase of iron & steel products with a view to commercial resale or with a view to use in the production of goods for commercial sale.

2 Definitions

- 2.1 **Bidder** may be a domestic/ foreign manufacturer of iron & steel or their selling agents/ authorized distributors/ authorized dealers/ authorized supply houses or any other company engaged in the bidding of projects funded by Government agencies.
- 2.2 **Domestically Manufactured Iron & Steel Products (DMI&SP)** are those iron and steel products which are manufactured by entities that are registered and established in India, including in Special Economic Zones (SEZs). In addition, such products shall meet the criteria of domestic minimum value-addition as mentioned in Appendix A.
- 2.3 **Domestic Manufacturer** is a manufacturer of iron & steel products conforming to guidelines in section 7 and confirming to the definition of 'manufacturer' as per Central Excise Act.
- 2.4 **Government** for the purpose of the Policy means Government of India.
- 2.5 **Government agencies** include Government PSUs, Societies, Trusts and Statutory bodies set up by the Government.
- 2.6 **MoS** shall mean Ministry of Steel, Government of India.
- 2.7 **Net Selling Price** shall be the invoiced price excluding net domestic taxes and duties
- 2.8 **Semi-Finished Steel** shall mean Ingots, billet, blooms and slabs, which can be subsequently processed to finished steel.
- 2.9 **Finished Steel** shall mean Flat and Long products, which can be subsequently processed into manufactured items.
- 2.10 **L1** means the lowest tender or the lowest bid or the lowest quotation received in a tender, bidding process or other procurement solicitation as adjudged in the evaluation process as per the tender or other procurement solicitation.
- 2.11 **Margin of purchase preference** means the maximum extent to which the price quoted by a domestic supplier may be above L1 for the purpose of purchase preference. In case of DMI&SP policy, the margin of purchase preference shall be 20% for items in Appendix B.
- 2.12 **Iron & Steel Product(s)** shall mean such iron and steel product(s) which are mentioned in Appendix A.
- 2.13 **Domestic value addition** shall be the net selling price (invoiced price excluding net domestic taxes and duties) minus the landed cost of imported input materials at the manufacturing plant in India (including all customs duties) as a proportion of the net selling price, in percent. The 'domestic value addition' definition shall be in line with the DPIIT (formerly DIPP) guidelines, and shall be suitably amended in case of any changes by DPIIT in the future. For the purpose of this policy document, domestic value addition and local content have been used interchangeably.

3 Exclusions

3.1 Waivers shall be granted by the Ministry of Steel to all such Government procurements subject to the below conditions.

3.1.1 Where specific grades of steel are not manufactured in the country, or

3.1.2 Where the quantities as per the demand of the project cannot be met through domestic sources

The exclusion requests shall be submitted to the Standing Committee along with sufficient proof of unavailability of domestically manufactured iron & steel products

4 Standing Committee

A Standing Committee under the Ministry of Steel (MoS) to be chaired by the Secretary (Steel), shall be constituted to oversee the implementation of the policy. The Committee shall comprise of experts drawn from Industry / Industry Association / Government Institution or Body / Ministry of Steel (MoS). The said Committee in MoS shall have the mandate for the following:

4.1 Monitoring the implementation of the policy

4.2 Review and notify the list of Iron & Steel products and the domestic value addition requirement criteria as mentioned at Appendix A and Appendix B.

4.3 Issue necessary clarifications for implementation of the policy including grant of exclusions to procuring agencies as per section 3

4.4 Constitute a separate committee to carry out grievance redressal

4.5 The Standing Committee shall submit its recommendations for approval to Ministry of Steel.

5 Notifying Iron & Steel Products Procured by Government

5.1 The following guidelines may be used for identifying and notifying the aforementioned products under the policy:

5.1.1 The policy is applicable to iron & steel products as provided in Appendix A and to capital goods for manufacturing iron & steel products in Appendix B.

5.1.2 Appendix A contains list of iron & steel products which are to be exclusively domestically manufactured and cannot be imported without the approval of the Ministry of Steel

5.1.3 Appendix B contains a list (non-exhaustive) of capital goods for which purchase preference shall be provided to domestically manufactured capital goods, if their quoted price falls within 20% of the price quoted for corresponding imported capital good.

5.1.4 The objective of the policy is to notify all iron & steel products which are procured by Government Agencies for government projects and not with a view to commercial resale or with a view to use in the production of products for commercial sale.

5.1.5 The policy is applicable to all projects funded by Ministry or Department of Government and all agencies/entities under their administrative control for purchase of iron & steel products.

5.1.6 The policy shall be applicable to projects where the procurement value of iron and steel products is greater than Rs. 25 crores. The policy shall also be applicable for other procurement (non-project), where annual procurement value of iron and steel products for that Government organization is greater than Rs. 25 crores.

5.1.7 The policy is applicable to purchase of iron & steel products by private agencies for fulfilling an EPC contract and/or any other requirement of Ministry or Department of Government or their PSUs.

5.1.8 Analysis of the availability of various grades of domestic iron and steel products needs to precede for notification under the policy. Only those iron & steel products, in respect of which at least one domestic manufacturer exists, shall be notified. Consultation may be carried out by the Standing Committee.

5.1.9 The policy is applicable to capital goods for manufacturing iron & steel products in Appendix B produced in compliance to prescribed quality standards, as applicable.

5.1.10 Policy for domestic procurement of capital goods for manufacturing iron and steel products is applicable to all public sector steel manufacturers and all agencies/entities under their administrative control for purchase of capital goods for manufacturing iron & steel products, not with a view to commercial resale.

5.1.11 The policy is applicable to purchase of capital goods for manufacturing iron & steel products by private agencies for fulfilling an EPC contract and/or any other requirement of public sector steel manufacturers and all agencies/entities under their administrative control

- 5.1.12 Government agencies which are involved in procurement of iron and steel products, and capital goods for manufacturing of iron and steel products, in cases where the iron and steel products are not mentioned in Appendix A and Appendix B, shall provide description and technical specifications of the product along with prescribed standards to the Standing Committee. The Standing Committee will act as per mandate in section 3 and section 4.
- 5.2 The Ministry of Steel (MoS) would notify iron & steel products along with the minimum prescribed domestic value addition, furnished at Appendix A.
- 5.3 The policy guidelines on capital goods for manufacturing iron & steel products shall be applicable to public sector steel manufacturers for all purchases of capital goods for manufacturing iron & steel products in Appendix B, irrespective of the project size.
- 5.4 Minimum domestic value addition requirement suggested for iron and steel products in Appendix A, and for capital goods for manufacturing iron and steel products in Appendix B have been decided on the basis of factors such as domestic supplier base, number of suppliers and import to consumption ratio.
- 5.5 The domestic value addition requirement norm shall be so calibrated that it reflects the average/above average manufacturing capability of the domestic industry for the iron & steel products at a point of time. This shall be suitably reviewed by the Standing Committee from time to time and amended, if required with the approval of Ministry of Steel.

6 Tender procedure for procurement by government and government agencies

- 6.1 The procuring/ Government agencies shall follow standard procurement procedures, in accordance with instructions of Ministry of Finance and CVC while adhering to DMI&SP. The policy shall come into effect from the date of its notification in all tenders where price bid have not been opened.
- 6.2 The tender document, for procurement of both Goods as well as for EPC contracts, should explicitly outline the qualification criteria for adherence to minimum prescribed domestic value addition by the bidder for iron and steel products and capital goods for manufacturing iron & steel products(as indicated in Appendix A and Appendix B)
- 6.3 In supporting the growth of domestic products, the target of domestic value addition in iron and steel business activities has been set as contained in **Appendix A and Appendix B**.
- 6.4 For iron and steel products in Appendix A, the procurement process shall be open only to the manufacturers / suppliers having the capability of meeting / exceeding the domestic value addition targets. Manufacturers / suppliers not meeting the domestic value addition targets are not eligible to participate in the bidding.
- 6.5 In case of Appendix B items, if in the opinion of the procuring company, the tenders (procured quantity) cannot be divided in the prescribed ratio of 50:50, then they shall have the right to award contract to the eligible domestic manufacturer for quantity not less than 50%, as may be divisible.
- 6.6 In continuation to the above clause, for Appendix B items, if the tendered item is non divisible, (to be included in the tender document by procuring company) the contract can be awarded to the eligible domestic manufacturer for the entire quantity.
- 6.7 In case of Appendix B items, if none of the eligible manufacturers meeting domestic value addition requirements match the L1 bid, the original bidder holding L1 bid shall secure the order for full value of procurement.
- 6.8 The bidders who are selling agents/ authorized distributors/ authorized dealers/ authorized supply houses of the domestic manufacturers of iron & steel products are eligible to bid on behalf of the domestic manufacturers under the policy. However, this shall be subject to the following conditions:
- 6.8.1 The bidder shall furnish the authorization certificate issued by the domestic manufacturer for selling domestically manufactured iron & steel products.
- 6.8.2 In case the procurement is covered under Appendix A of the DMI&SP policy, the bidder shall furnish the Affidavit of self-certification issued by the domestic manufacturer to the procuring agency declaring that the iron & steel products is domestically manufactured in terms of the domestic value addition prescribed.
- 6.8.3 In case the procurement is covered under Appendix B of the DMI&SP policy, the bidder shall furnish the certification issued by the statutory auditor to domestic manufacturer declaring that the capital goods to be used in Iron & Steel industry are domestically manufactured in terms of the domestic value addition prescribed.
- 6.8.4 It shall be the responsibility of the bidder to furnish other requisite documents required to be issued by the domestic manufacturer to the procuring agency as per the policy.

7 Domestic value addition requirement

- 7.1 Minimum domestic value addition requirement to qualify the product as a domestically manufactured iron & steel product or a Capital good are mentioned in Appendix A and B.
- 7.2 Domestic value addition shall be the net selling price (invoiced price excluding net domestic taxes and duties) minus the landed cost of imported input materials at the manufacturing plant in India (including all customs duties) as a proportion of the net selling price, in per cent.
- 7.2.1 In case the iron & steel products are made using domestic input steel (semi-finished/ finished steel), invoices of purchases from the actual domestic producers along with quantities purchased and the other related documents must be furnished to the procuring Government agency.
- 7.2.2 In case the iron & steel products have imported input steel, the invoices of purchases from the actual producers along with quantities purchased and the other related documents must be furnished separately. To derive the extent of domestic value addition, the weighted average of both (imported & domestic) input steel shall be considered to ensure that the minimum stipulated domestic value addition requirement of the policy is complied with.
- 7.3 It is recommended that each bidder participating in the tender process should calculate the domestic value addition using the below formula below so as to ensure the domestic value addition claimed is consistent with the minimum stipulated domestic value addition requirement of the policy.

For Iron and Steel products

% Domestic value addition

$$= \frac{\text{Net selling price of final product} - \text{Landed cost of imported iron or steel at plant}}{\text{Net selling price of final product}} \times 100\%$$

For Capital Goods

% Domestic value addition

$$= \frac{\text{Net selling price of final product} - \text{Landed cost of imported input materials at plant}}{\text{Net selling price of final product}} \times 100\%$$

8 Certification and audit

- 8.1 For products in Appendix A, each domestic manufacturer shall furnish the Affidavit of self-certification to the procuring Government agency declaring that the iron & steel products are domestically manufactured in terms of the domestic value addition prescribed. For capital goods in Appendix B, the bidder shall furnish the certification issued by the statutory auditor to the domestic manufacturer declaring that the capital goods are domestically manufactured in terms of the domestic value addition prescribed. The bidders who are sole selling agents / authorized distributors / authorized dealers / authorized supply houses of the domestic manufacturers of iron & steel products are eligible to bid on behalf of domestic manufacturers under the policy. The bidder shall furnish the Affidavits of self-certification issued by the domestic manufacturers and the certifications issued by the statutory auditors, to the procuring agency declaring that the iron & steel products are domestically manufactured in terms of the domestic value addition prescribed. The Affidavit of self-certification shall be furnished in **Form I** attached to these guidelines.
- 8.2 It shall be the responsibility of the domestic manufacturer to ensure that the products so claimed are domestically manufactured in terms of the domestic value addition prescribed for the product. The bidder shall also be required to provide a domestic value addition certificate on half-yearly basis (Sep 30 and Mar 31), duly certified by the Statutory Auditors of the domestic manufacturer, that the claims of domestic value addition made for the product during the preceding 6 months are in accordance with the Policy. Such certificate shall be filed within 60 days of commencement of each half year, to the concerned Government agencies and shall continue to be filed till the completion of supply of the said products.
- 8.3 The procuring agency shall accept the Affidavit of self-certification regarding domestic value addition in a steel product submitted by a bidder. It shall not normally be the responsibility of procuring agency to verify the correctness of the claim. The onus of demonstrating the correctness of the same shall be on the bidder when asked to do so.
- 8.4 In case a complaint is received by the procuring agency or the concerned Government Agency against the claim

of a bidder regarding domestic value addition in iron & steel products, the procuring agency shall have full rights to inspect and examine all the related documents and take a decision. In case any clarification is needed, matter may be referred to MoS with a request for technical assistance.

- 8.5 Any complaint referred to the Government Agency shall be disposed off within 4 weeks of the reference along with submission of all necessary documents. The bidder shall be required to furnish the necessary documentation in support of the domestic value addition claimed in iron & steel products to the Government Agency within 2 weeks of filing the complaint.
- 8.6 In case, the matter is referred to the Ministry of Steel, the grievance redressal committee setup under the MoS shall dispose of the complaint within 4 weeks of its reference and receipt of all documents from the bidder after taking in consideration, the view of the Government Agency. The bidder shall be required to furnish the necessary documentation in support of domestic value addition claimed in iron & steel products to the grievance redressal committee under MoS within 2 weeks of the reference of the matter. If no information is furnished by the bidder, the grievance redressal committee may take further necessary action, in consultation with Government Agency to establish bonafides of claim.
- 8.7 The cost of assessing the prescribed extent of domestic value addition shall be borne by the procuring agency if the domestic value addition is found to be correct as per the certificate. However, if it is found that the domestic value addition as claimed is incorrect, the cost of assessment will be payable by the bidder who has furnished an incorrect certificate. The manner of enforcing the same shall be defined in the tender document.

9 Sanctions

- 9.1 Each Government Agency shall clearly define the penalties, in case of wrong declaration by the bidder of the prescribed domestic value addition, in the tender document. The penalties may include forfeiting of the EMD, other financial penalties and blacklisting of such manufacturer/ service provider.
- 9.2 In case of reference of any complaint to MoS by the concerned bidder, there would be a complaint fee of Rs. 10 Lakh or 0.2 % of the value of the DMI&SP being procured (subject to a maximum of Rs. 20 Lakh), whichever is higher, to be paid by Demand Draft deposited with the grievance redressal committee under MoS along with the complaint by the complainant. In case, the complaint is found to be incorrect, the Government Agency reserves the right to forfeit the said amount. In case, the complaint is found to be substantially correct, deposited fee of the complainant would be refunded without any interest.

10 Implementation monitoring by Ministry of Steel

- 10.1 The policy provisions shall be applicable for a period of 5 years from the date of publication. The policy period may further be extended at the discretion of Ministry of Steel.
- 10.2 MoS shall be the nodal ministry to monitor the implementation of the policy.
- 10.3 All applicable agencies under DMI&SP policy shall ensure implementation of the policy and shall annually, in the month of June, send a declaration indicating the extent of compliance to the policy and reasons for noncompliance thereof, during the preceding financial year.

Reference to Ministry of Steel

In case of a question whether an item being procured is a DMI&SP to be covered under the policy, the matter would be referred to the Ministry of Steel for clarification.

Appendix A - Exclusive for domestically manufactured products

Sl. No.	Indicative list of Iron & Steel Products	Applicable HS code	Minimum domestic value addition requirement
1	Flat-rolled products of iron or non alloy steel, of a width of 600 mm or more, hot rolled, not clad, plated or coated	7208	50%
2	Flat-rolled products of iron or non alloy steel, of a width of 600 mm or more, cold rolled (cold-reduced), not clad, plated or coated	7209	50%
3	Flat-rolled products of iron or non alloy steel, of a width of 600 mm or more, clad, plated or coated	7210	50%

4	Flat-rolled products of iron or non alloy steel, of a width of less than 600 mm, not clad, plated or coated	7211	35%
5	Flat-rolled products of iron or non alloy steel, of a width of less than 600 mm, clad, plated or coated	7212	35%
6	Bars and rods, hot-rolled, in irregularly wound coils, of iron or non-alloy steel	7213	35%
7	Other bars and rods of iron or non alloy steel, not further worked than forged, hot rolled, hot-drawn or hot-extruded, but including those twisted after rolling	7214	35%
8	Other bars and rods of iron or non alloy steel	7215	35%
9	Angles, shapes and sections of iron or non-alloy steel	7216	35%
10	Wire of iron or non-alloy steel	7217	50%
11	Flat-rolled products of stainless steel, of a width of 600 mm or more	7219	50%
12	Flat-rolled products of stainless steel, of a width of less than 600 mm	7220	50%
13	Other bars and rods of stainless steel; angles, shapes and sections of stainless steel	7222	50%
14	Wire of other alloy steel	7229	35%
15	Rails, railway or tramway track construction material of iron or steel	7302	50%
16	Tubes, pipes and hollow profiles, of cast iron	7303	35%
17	Tubes, pipes and hollow profiles, seamless, of iron (other than cast iron) or steel	7304	35%
18	Other tubes and pipes (for example, welded, riveted or similarly closed), having circular cross-sections, the external diameter of which exceeds 406.4 mm, of iron or steel	7305	35%
19	Other tubes, pipes and hollow profiles (for example, open seam or welded, riveted or similarly closed), of iron or steel	7306	35%
20	Tube or pipe fittings (for example, connectors/couplings, elbow sleeves), of iron or steel	7307	35%
21	Bars and rods, hot-rolled, in irregularly wound coils, of stainless steel	7221	35%
22	Wire of stainless steel	7223	35%
23	Flat-rolled products of other alloy steel, of a width of 600 mm or more, including electrical steel	7225	35%
24	Flat-rolled products of other alloy steel, of a width of less than 600 mm, including electrical steel	7226	35%
25	Bars and rods, hot-rolled, in irregularly wound coils, of other alloy steel	7227	15%
26	Other bars and rods of other alloy steel; angles, shapes and sections, of other alloy steel; hollow drill bars and rods, of alloy or nonalloy steel	7228	35%
27	Sheet piling of iron or steel, whether or not drilled, punched or made from assembled elements; welded angles, shapes and sections, of iron or steel	7301	15%
28	Structures (excluding prefabricated buildings of heading 9406) and parts of structures	7308	15%
29	Reservoirs, tanks, vats and similar containers for any material (other than compressed or liquefied gas), of iron or steel, of a capacity exceeding 300 whether or not lined or heatinsulated, but not fitted with mechanical or Thermal equipment	7309	15%

30	Tanks, casks, drums, cans, boxes and similar containers, for any material (other than compressed or liquefied gas), of iron or steel, of a capacity not exceeding 300 L, whether or not lined or heat-insulated, but not fitted with mechanical or thermal equipment	7310	15%
31	Containers for compressed or liquefied gas, of iron or steel	7311	15%
32	Stranded wire, ropes, cables, plaited bands, slings and the like, of iron or steel, not electrically insulated	7312	15%
33	Barbed wire of iron or steel; twisted hoop or single flat wire, barbed or not, and loosely twisted double wire, of a kind used for fencing, of iron or steel	7313	15%
34	Grill, netting and fencing, of iron or steel wire; expanded metal of iron or steel	7314	15%
35	Chain and parts thereof, of iron or steel	7315	15%
36	Anchors, grapnels and parts thereof, of iron or steel	7316	15%
37	Articles of iron and steel	7317	15%
38	Articles of iron and steel	7318	15%
39	Articles of iron and steel	7319	15%
40	Springs and leaves for springs, of iron or steel	7320	15%
41	Stoves, ranges, grates, cookers (including those with subsidiary boilers for central heating), barbecues, braziers, gas-rings, plate warmers and similar non-electric domestic appliances, and parts thereof, of iron or steel	7321	15%
42	Radiators for central heating, not electrically heated, and parts thereof, of iron or steel; air heaters and hot air distributors, not electrically heated, incorporating a motor-driven fan or blower, and parts thereof, of iron or steel	7322	15%
43	Tables and similar household articles and parts thereof, of iron or steel	7323	15%
44	Sanitary ware and parts thereof, of iron or steel	7324	15%
45	Other cast articles of iron or steel	7325	15%
46	Electrical steel and other articles of iron or steel	7326	15%
47	Railway or tramway passenger coaches, not self-propelled	8605	50%
48	Railway or tramway goods vans and wagons, not self-propelled	8606	50%
49	Parts of railway or tramway locomotives or rolling-stock; such as bogies, bissel-bogies, axles and forged wheels, and parts thereof	8607	50%

Products included in descriptions are indicative; all products under the specified HS codes are included as part of the appendix

Appendix B

Indicative list of capital goods(non-exhaustive) for manufacturing iron & steel products

Sl. No.	Plant shop	Capital goods	Minimum domestic value addition requirement
1	Raw material handling system	Apron feeder, barrel couplings, heavy duty bearings, hydraulic disc brakes, tanker & container for powdered materials, conveyor belt for pipe conveyors, high angle conveyor system, crushers, crane rail lubrication system, four girder EOT Crane, crane weighing system, crane air conditioning, fluid couplings, fork lift trucks, hydraulic motors, hydraulic system, locking assembly (friction grip), load cells, level sensors, pipe	50%

		conveyor system, plough/ paddle feeder, pneumatic transportation - dense & lean phase, reclaimers, radio remote control, rail fixing arrangements (special), rapid/ flood loading system, stackers, special screen, slew ring bearings, tippers, transfer cars, tongs (special), vibration, isolation system (spring damper), wagon tippers, wagon loaders	
2	Mineral beneficiation (iron ore and coal) equipment	Industrial crushers, grinding mills, conventional screens, slurry pumps, hire thickeners, filters, hydroclones	50%
3	Coke oven	Coke Oven Silica Refractory, Anchorage System, Waste gas valve with branch pipe, Flash Plate, Door Frame, door body, Minor Casting: Gooseneck, Valve box, AP Lid, Charging & inspection hole lid and frame Reversing mechanism, Centralised lubrication system, Hydrojet Door Cleaning Mechanism, Spillage code conveyor system, skip hoist, Door Lowering Rack, Isolation/ Reversing Cocks, Level II automation, Oven machines	50%
4	By-product plant	Primary Gas Cooler, Electrostatic Tar Precipitator, H ₂ S, NH ₃ & Naphthalene Scrubber, Combi Stripper, Flushing Liquor Pump, Claus Kiln, Claus reactors, Waste Heat Boilers, Decanters	50%
5	Sinter plant equipment	Pallet car, Drive/discharge end Sprocket assembly, Curved rail, Slide rails, Hot sinter breaker and Grizzly, Dip rail & running rail, Impeller assembly for Process fan, Drive assembly of Sinter machine, Hi-intensity Mixer & Noduliser	50%
6	Pellet plant equipment	Pallet car, Drive/discharge end Sprocket assembly, Curved rail, Slide rails, running rail, Vertical roller mill, Impeller assembly for Process fan, Drive assembly of Indurating machine, Hi-intensity Mixer, Balling disc, Single deck roller screen and Double deck roller screen	50%
7	Blast furnace equipment	Bell less top system with Bleeder valve, SG Iron stove coolers, Copper stove coolers, Stock level indicator (Radar Type), Mud gun, Drilling machine and Manipulator, Gas Cleaning Plant system, Top Recovery Turbine system including its by-pass valve, De-bricking Machine, Re-railing equipment, PCI system, Grinding mill for PCI, Stock level indicator, Tuyere Stock assembly, Waste Heat Recovery system, BF & Hot Blast Stoves Technological Valves, Above Burden probes, Slag granulation unit, Tuyere & Tuyere cooler, Torpedo Ladle Car, BF hearth refractory	50%
8	Direct reduction plant equipment	Charge distributor, Upper & lower seal leg, Reformer & Re-cuperator system, Burden feeders, Turbo-expander, Process Gas Compressor, Seal gas compressors & bottom seal gas compressors, Seal gas generators & driers, Process Gas Heater, CO ₂ removal plant	50%
9	Basic oxygen furnace equipment	Main and Maintenance equipment comprising of converter, gunning machine, Refractory/ slag monitoring device, converter vessel, trunnion ring and suspension system, trunnion bearings and housing, Converter bull gear unit and tilt drive system, Rotary joint for converter, bottom stirring system, Lance body with clamping, Lance copper tips, Valve stations for oxygen blowing/ bottom stirring, Sub-lance system, Off gas analyzer with process module i.e. Process software/ hardware, container lab Measurement probes, Switch over station, ID fan for primary gas, Hot metal and steel ladle, Ladle Transfer car, Ladle maintenance equipment, Slag pot, Slag pot transfer car, Scrap boxes, Scrap Transfer car, Lance carriage, Lance guide, Crane & hoist, Lance hoist & trolley, Lance tilting device, Traverse for lifting lances, Bunker of various sizes, Bin Vibrator, Weighing Hopper, Maintenance stands, De dusting suction hood, Teeming/HM, ladle relining stands, Stand Cooling stack inspection device, Hood traverse carriage, Refractories, Bypass & isolation valves, Flare stack & ignition system, Scrubbing tower	50%

		shell - Wet gas cleaning system, Dog house, Ladle drier, ladle pre-heater, ladle cooler, Fume collection hoods, Clean gas stack, Dust silo, Weigh Bridge, Slag retaining device	
10	Electric arc furnace	Furnace proper (includes furnace lower shell, upper shell and roof, Tilting platform, Furnace Gantry) and transformer, Electrode regulation system, Hydraulic system, Refractories, Parts of Level I & Level II Automation system. LF - water cooled ladle roof, electrode mast and arms, electrode regulating system, wire feeding system, Bottom inert gas stirring Valve stand for porous plug and top lance, Emergency lance mechanism, Lance carriage system with drive unit, Automatic temperature, sampling & bath level / O ₂ measurement, Temp. & oxygen immersion lance, lance carriage system with drive unit, Hydraulic system, Refractories, Ladle roof Delta portion, RH proper (includes Ladle transfer car, vacuum vessel, Vessel lifting & lowering system. Hydraulic system, Multi Function lance, Valve racks/station, Electrode clamp unit, conductor of electrode arms, water cooled cable, A R stirring valve rack, lance transport car, Refractory lance, Hydraulic cylinder, Ladle roof lifting cylinder, Lubrication system, Suction hood, damper, Vibro feeder, weighing hopper, wire feeding system, Electrode nipping stand, Cranes, hoist, Temperature & sampling tips, ladle stands, ESP, Deducing hoods, Refractories, bag filter, Cranes etc.	50%
11	Continuous casting equipment	Ladle turret, ladle cover manipulator, Ladle Shroud manipulator, tundish car, Continuous tundish temperature measurement system, Tundish stopper rod mechanism, emergency cut-off gate, mould assembly, Nozzle quick change device, mould oscillator and EMS system. Electro-Magnetic braking system, Strand guide segment, Withdrawal & Straightening unit (WSU), Roll gap checker, Emergency torch cutter, Torch cutting machine, Deburrer, Marking machine, Technological control system & process models, Black Refractories, strand gunde segment, tundish, ladle cover, roller tables & auxiliaries, mould& segment maintenance equipments, tundish maintenance equipments, EMBR system	50%
12	Flat product mills	Large castings and forgings like mill housing, bed plates, work rolls, backup rolls, end spindles; roller tables, backup roll and work roll chucks, coilers / tension reels / uncoilers, AGC cylinders, shears, levelers, lazer welders, packaging machines, non-contact gauges / profile gauges, anti-friction roll neck bearings, oil film bearings, gear boxes, mill motors	50%
13	Long product mills	Mill housing, bed plates, work rolls, backup rolls, spindles; roller tables, coilers / tension reels / uncoilers, shears, billet welder, packaging machines, non-contact gauges / profile gauges, anti-friction roll neck bearings, oil film bearings, finishing blocks, gear boxes, mill motors	50%

**Items in appendix B are an indicative list of capital goods for manufacturing steel, the list is not exhaustive. All capital goods for steel manufacturing shall be considered for purchase preference under the policy with a minimum domestic value addition requirement of 50%*

Form-1

Format for Affidavit of Self Certification regarding Domestic Value Addition in Iron & Steel Products/capital goods to be provided on Rs.100/- Stamp Paper Date:

I _____ S/o, D/o, W/o, _____ Resident of _____ hereby solemnly affirm and declare as under:

That I will agree to abide by the terms and conditions of the policy of Government of India issued vide Notification No: _____.

That the information furnished hereinafter is correct to the best of my knowledge and belief and I undertake to produce relevant records before the procuring agency (ies) for the purpose of assessing the domestic value addition.

That the domestic value addition for all inputs which constitute the said iron & steel products has been verified by me and I am responsible for the correctness of the claims made therein.

That in the event of the domestic value addition of the product mentioned herein is found to be incorrect and not meeting the prescribed value-addition criteria, based on the assessment of procuring agency (ies) for the purpose of assessing the domestic value-addition, I will be disqualified from any Government tender for a period of 36 months. In addition, I will bear all costs of such an assessment.

That I have complied with all conditions referred to in the Notification No. _____ wherein preference to domestically manufactured iron & steel products in Government procurement is provided and that the procuring agency (ies) is hereby authorized to forfeit and my EMD. I also undertake to pay the assessment cost and pay all penalties as specified in the tender document.

I agree to maintain the following information in the Company's record for a period of 8 years and shall make this available for verification to any statutory authority.

- i. Name and details of the Bidder (Registered Office, Manufacturing unit location, nature of legal entity)
- ii. Date on which this certificate is issued
- iii. Iron & Steel Products for which the certificate is produced
- iv. Procuring agency to whom the certificate is furnished
- v. Percentage of domestic value addition claimed and whether it meets the threshold value of domestic value addition prescribed
- vi. Name and contact details of the unit of the manufacturer (s)
- vii. Net Selling Price of the iron & steel products
- viii. Freight, insurance and handling till plant
- ix. List and total cost value of input steel (imported) used to manufacture the iron & steel products
- x. List and total cost of input steel which are domestically sourced.
- xi. Please attach domestic value addition certificates from suppliers, if the input is not in house.
- xii. For imported input steel, landed cost at Indian port with break-up of CIF value, duties & taxes, port handling charges and inland freight cost.

For and on behalf of (Name of firm / entity)

Authorized signatory (To be duly authorized by the Board of Directors)

<Insert Name, Designation and Contact No.>



भारत का राजपत्र
The Gazette of India

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असाधारण
EXTRAORDINARY

भाग II—खण्ड 3—उप-खण्ड (i)
PART II—Section 3—Sub-section (i)

प्राधिकार से प्रकाशित
PUBLISHED BY AUTHORITY

सं. 1]
No. 1]

नई दिल्ली, शुक्रवार, जनवरी 1, 2021/पौष 11, 1942
NEW DELHI, FRIDAY, JANUARY 1, 2021/PAUSHA 11, 1942

इस्पात मंत्रालय

अधिसूचना

नई दिल्ली, 31 दिसम्बर, 2020

सा.का.नि. 1(अ).—सरकारी प्रापण में देशी निर्मित लोहा और इस्पात उत्पादों को प्राथमिकता प्रदान करने हेतु नीति (डीएमआई एंड एसपी नीति) - परिशोधित, 2019 में संशोधनों को आम सूचना के लिए एतद्वारा प्रकाशित किया जाता है:

"सं. S-13026/1/-2020-आईडीडी

इस्पात मंत्रालय

आईडीडी प्रभाग

उद्योग भवन,

नई दिल्ली 31 दिसंबर, 2020

विषय : सरकारी खरीद में घरेलू निर्मित लोहा और इस्पात उत्पादों को प्राथमिकता प्रदान करने की नीति-परिशोधित, 2019-में संशोधन/परिवर्धन

सरकारी खरीदमें स्वदेशी निर्मित लोहा और इस्पात उत्पादों को प्राथमिकता प्रदान करने की नीति-परिशोधित, 2019-(डीएमआईएंडएसपी परिशोधित, 2019) में निम्नलिखित संशोधन/ परिवर्धन तत्काल प्रभाव से लागू हैं। ये संशोधन/

परिवर्धन ऐसी निविदा या खरीद पर लागू नहीं होंगे जिनके लिए निविदा आमंत्रित करने वाला नोटिस अथवा अन्य प्रकार का खरीद अधिवाचन इस अधिसूचना के जारी होने से पूर्व जारी हुआ है।

1 - संशोधन:तालिका 1

क्रम सं.	डीएमआईएंडएसपी परिशोधित 2019 ,में मौजूदा खंड	डीएमआईएंडएसपी परिशोधित 2019 ,में संशोधित खंड
1	<p>खंड 1.3:</p> <p>यह नीति सरकार के प्रत्येक मंत्रालय अथवा विभाग और उनके प्रशासनिक नियंत्रण के अधीन सभी एजेंसियों/ प्रतिष्ठानों तथा सरकारी परियोजनाओं के वास्ते लौह एवं इस्पात उत्पादों की खरीद के लिए इन एजेंसियों द्वारा वित्तपोषित परियोजनाओं पर लागू है। हालांकि, यह नीति वाणिज्यिक पुनः बिक्री के उद्देश्य से अथवा वाणिज्यिक बिक्री के लिए वस्तुओं के उत्पादन में उपयोग करने के उद्देश्य से लौह एवं इस्पात उत्पादों की खरीद पर लागू नहीं होगी।</p>	<p>खंड 1.3:</p> <p>यह नीति सरकार के प्रत्येक मंत्रालय अथवा विभाग और उनके प्रशासनिक नियंत्रण के अधीन सभी एजेंसियों/ प्रतिष्ठानों तथा सरकारी परियोजनाओं के वास्ते लौह एवं इस्पात उत्पादों की खरीद के लिए इन एजेंसियों द्वारा वित्त पोषित परियोजनाओं पर लागू है। केन्द्रीय क्षेत्र की सभी योजनाएं (सीएस)/ केन्द्रीय प्रायोजित योजनाएं (सीएसएस) जिनके लिए राज्यों और स्थानीय निकायों द्वारा खरीद की जाती है, इस नीति की परिधि में आएंगी यदि उस परियोजना/योजना को भारत सरकार द्वारा पूर्णतया/ अंशतः वित्तपोषित किया जाता है।</p> <p>हालांकि, यह नीति वाणिज्यिक पुनः बिक्री के उद्देश्य से अथवा वाणिज्यिक बिक्री के लिए वस्तुओं के उत्पादन में उपयोग करने के उद्देश्य से लौह एवं इस्पात उत्पादों की खरीद पर लागू नहीं होगी।</p>
2	<p>खंड 2.13:</p> <p>घरेलू मूल्यवर्धन निवल बिक्री कीमत(निवलघरेलू करों और शुल्कों को छोड़कर बीजक कीमत) होगी जिससे प्रतिशत में निवल बिक्री कीमत के एक अनुपात के रूप में भारत में निर्माण संयंत्र(सभी सीमा शुल्कों सहित) में आयात की गई इनपुट सामग्री की पहुंच लागत घटाई गई हो, 'घरेलू मूल्यवर्धन'परिभाषा डी पी आई आई टी (पूर्व में डी आई पी पी) के दिशानिर्देशों के अनुरूपहोगी और उसमें भविष्य में डी पी आई आई टी द्वारा परिवर्तन किये जाने की स्थिति में उपयुक्त रूप से संशोधन किया जायेगा। इस नीति दस्तावेज के प्रयोजन के लिए घरेलूमूल्यवर्धन और स्थानीय विषय वस्तु का उपयोग एक दूसरे के स्थान पर किया गया है।</p>	<p>खंड 2.13:</p> <p>घरेलू मूल्यवर्धन का तात्पर्य है- भारत में वर्धित मूल्य की राशि जो खरीदी/बेची जाने वाली वस्तुओं का कुल मूल्य होगा (निवल घरेलू अप्रत्यक्ष करों को छोड़कर)- खरीदी/बेची जाने वाली वस्तुओं के कुल मूल्य के समानुपात के रूप में प्रतिशत में मद में आयातित सामग्री का मूल्य (सभी सीमा शुल्कों सहित)। घरेलू मूल्यवर्धन निवल बिक्री कीमत (निवल घरेलू करों और शुल्कों को छोड़कर बीजक कीमत) होगी जिससे प्रतिशत में निवल बिक्री कीमत के एक अनुपात के रूप में भारत में निर्माण संयंत्र (सभी सीमा शुल्कों सहित) में आयात की गई इनपुट सामग्री की पहुंच लागत घटाई गई हो, 'घरेलू मूल्यवर्धन'परिभाषा डी पी आई आई टी (पूर्व में डी आई पी पी) के दिशानिर्देशों के अनुरूप होगी और उसमें भविष्य में डी पी आई आई टी द्वारा परिवर्तन किये जाने की स्थिति में उपयुक्त रूप से संशोधन किया जायेगा। इस नीति दस्तावेज के प्रयोजन के लिए घरेलू मूल्यवर्धन और स्थानीय विषय वस्तु का उपयोग एक दूसरे के स्थान पर किया गया है।</p>

<p>3 खंड 5.1.5</p> <p>यह नीति सरकार के मंत्रालय अथवा विभाग के द्वारा वित्त-पोषित सभी परियोजनाओं और उनके प्रशासनिक नियंत्रण के अधीन सभी एजेंसियों/ प्रतिष्ठानों पर लौह एवं इस्पात उत्पादों की खरीद के लिए लागू है।</p>	<p>खंड 5.1.5</p> <p>यह नीति सरकार के मंत्रालय अथवा विभाग के द्वारा वित्त पोषित सभी परियोजनाओं और उनके प्रशासनिक नियंत्रण के अधीन सभी एजेंसियों/ प्रतिष्ठानों पर लौह एवं इस्पात उत्पादों की खरीद के लिए लागू है। केन्द्रीय क्षेत्र की सभी योजनाएं (सीएस)/ केन्द्रीय प्रायोजित योजनाएं (सीएसएस) जिनके लिए राज्यों और स्थानीय निकायों द्वारा खरीद की जाती है, इस नीति की परिधि में आएंगी यदि उस परियोजना/योजना को भारत सरकार द्वारा पूर्णतया/ अंशतः वित्तपोषित किया जाता है</p>
<p>4 खंड 5.1.6</p> <p>यह नीति उन परियोजनाओं पर लागू होगी जहां लौह एवं इस्पात उत्पादों का खरीद मूल्य 25 करोड़ रुपए से अधिक होता हो। यह नीति अन्य खरीद (गैर परियोजना) के लिए भी लागू होगी जहां उस सरकारी संगठन के लिए लौह एवं इस्पात उत्पादों का वार्षिक खरीद मूल्य 25 करोड़ रुपए से अधिक होता हो।</p>	<p>खंड 5.1.6</p> <p>यह नीति उन परियोजनाओं पर लागू होगी जहां लौह एवं इस्पात उत्पादों (डीएमआई एंड एसपी नीति का परिशिष्ट-क) का खरीद मूल्य 5लाख रुपए से अधिक होता हो। यह नीति अन्य खरीद (गैर परियोजना) के लिए भी लागू होगी जहां उस सरकारी संगठन के लिए लौह एवं इस्पात उत्पादों का वार्षिक खरीद मूल्य 5 लाख करोड़ रुपए से अधिक होता हो। तथापि, प्रापण इकाइयों द्वारा इस बात को सुनिश्चित किया जाएगा कि इस नीति के प्रावधानों से बचने के प्रयोजनार्थ खरीद का विभाजन न किया जाए।</p>
<p>5 खंड 7.2</p> <p>घरेलू मूल्यवर्धन निवल बिक्री कीमत (निवल घरेलू करों और शुल्कों को छोड़कर बीजककीमत) होगी जिसमें से प्रतिशत में निवल बिक्री कीमत के एक अनुपात के रूप में भारत में निर्माण करने वाले संयंत्र में आयात की गई इनपुट सामग्री की पहुंच लागत (सभी सीमा शुल्कों को शामिल करते हुए) घटाई जायेगी।</p>	<p>खंड 7.2</p> <p>घरेलू मूल्यवर्धन का तात्पर्य है- भारत में वर्धित मूल्य की राशि जो खरीदी/बेची जाने वाली वस्तुओं का कुल मूल्य होगा (निवल घरेलू अप्रत्यक्ष करों को छोड़कर)- खरीदी/बेची जाने वाली वस्तुओं के कुल मूल्य के समानुपात के रूप में प्रतिशत में मद में आयातित सामग्री का मूल्य (सभी सीमा शुल्कों सहित)।</p>
<p>6 खंड 7.3</p> <p>यह सिफारिश की जाती है कि निविदा की प्रक्रिया में भाग लेने वाले प्रत्येक बोली लगाने वाले को नीचे दिए गए सूत्र का उपयोग करते हुए घरेलू मूल्यवर्धन की गणना करनी चाहिए ताकि यह सुनिश्चित किया जा सके कि दावा किये गये घरेलू मूल्यवर्धन इस नीति के न्यूनतम निर्धारित घरेलू मूल्यवर्धन के अनुरूप है।</p> <p>लौह एवं इस्पात उत्पादों के लिए % घरेलू मूल्यवर्धन</p> <p>अंतिम उत्पाद की निवल बिक्री कीमत- संयंत्र में आयात किये गये लौह अथवा इस्पात की पहुंच लागत----- X100%</p>	<p>खंड 7.3</p> <p>यह सिफारिश की जाती है कि प्रापण करने वाली सरकारी एजेंसी/ निविदा की प्रक्रिया में भाग लेने वाले प्रत्येक बोली लगाने वाले को नीचे दिए गए सूत्र का उपयोग करते हुए घरेलू मूल्यवर्धन की गणना करनी चाहिए ताकि यह सुनिश्चित किया जा सके कि दावा किये गये घरेलू मूल्यवर्धन इस नीति के न्यूनतम निर्धारित घरेलू मूल्यवर्धन के अनुरूप है।</p> <p>लौह एवं इस्पात उत्पादों तथा पूंजीगत माल के लिए % घरेलू मूल्यवर्धन</p> <p>खरीदी/बेची जाने वाली वस्तु का कुल मूल्य (निवल घरेलू अप्रत्यक्ष करों को छोड़कर - मद में आयातित सामग्री का मूल्य (सभी सीमा शुल्कों सहित) ----- -----X100%</p>

अंतिम उत्पाद की निवल ब्रिकी कीमत पूँजीगत माल के लिए % घरेलू मूल्यवर्धन अंतिम उत्पाद की निवल ब्रिकी कीमत- संयंत्र में आयात किये गये इनपुट सामग्री की पहुंच लागत-----X 100% अंतिम उत्पाद की निवल ब्रिकी कीमत	खरीदी/बेची जाने वाली वस्तु का कुल मूल्य
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II डीएमआईएंडएसपी परिशोधित, 2019 के परिशिष्ट क में निम्नलिखित संशोधन किया जाता है:- जहां कहीं न्यूनतम घरेलू मूल्य वर्धन आवश्यकता कॉलम के अंतर्गत डीएमआईएंडएसपी परिशोधित, 2019 के परिशिष्ट क में 15% का न्यूनतम घरेलू मूल्य वर्धन विनिर्दिष्ट होगा, वहां उसे 20% न्यूनतम घरेलू मूल्यवर्धन से प्रतिस्थापित कर दिया जाएगा (परिशोधित परिशिष्ट-क संलग्न है)

III- परिवर्धन/सन्निवेशन: तालिका 2

क्रम सं	डीएमआईएंडएसपी परिशोधित, 2019 में शामिल/जोड़े गये खंड
1	<p>खण्ड 5.1.13 को खण्ड 5.1.12 के नीचे निम्नवत जोड़ा जाता है:</p> <p>खण्ड 5.1.13: लोहे और इस्पात उत्पादों की खरीद से संबंधित निविदाओं के लिए कोई वैश्विक निविदा इन्क्वायरी (जीटीई) आमंत्रित नहीं की जाएगी (डीएमआई और एसपी नीति का परिशिष्ट-क)। लोहे और इस्पात उत्पादों के विनिर्माण जिनका अनुमानित मूल्य 200 करोड़ रु तक हो, (डीएमआई और एसपी नीति के परिशिष्ट- ख) के लिए पूँजीगत सामानों की खरीद से संबंधित निविदाओं के लिए कोई वैश्विक निविदा इन्क्वायरी (जीटीई) व्यय विभाग द्वारा यथा नाम-निर्दिष्ट सक्षम प्राधिकारी के अनुमोदन के अलावा आमंत्रित नहीं की जाएगी,</p>
2	<p>खंड 6.9 को खंड 6.8 के नीचे निम्नवत जोड़ा जाता है:</p> <p>खंड 6.9: निविदाओं और अन्य खरीद अधियाचनों में विनिर्देशन:</p> <p>6.9.1 प्रत्येक क्रय इकाई यह सुनिश्चित करेगी कि किसी भी निविदा या अधियाचन में निर्धारित पिछले अनुभव के संबंध में पात्रता की शर्तों हेतु अन्य देशों में आपूर्ति के प्रमाण या निर्यात के प्रमाण की आवश्यकता नहीं है।</p> <p>6.9.2 क्रय इकाईयाँ यह देखने का प्रयास करेंगी कि पात्रता की शर्तों, जैसे टर्नओवर, उत्पादन क्षमता और वित्तीय ताकत जैसे मामलों में वैसे स्थानीय आपूर्तिकर्ता का अनुचित अपवर्जन नहीं होता है जो आपूर्तिकर्ता की गुणवत्ता या साख संबंधी पात्रता सुनिश्चित करने के लिए जो आवश्यक है, उससे परे अन्यथा पात्र होंगे।</p> <p>6.9.3 क्रय इकाईयाँ, इस नीति के जारी होने के 2 महीने के भीतर ऊपर उप-पैराग्राफ 6.9.1 और 6.9.2 के संदर्भ में सभी मौजूदा पात्रता मानदंडों और शर्तों की समीक्षा करेंगी।</p> <p>6.9.4 यदि इस्पात मंत्रालय इस बात से संतुष्ट है कि लौह और इस्पात उत्पादों के भारतीय आपूर्तिकर्ताओं को प्रतिबंधात्मक निविदा शर्तों के कारण किसी भी विदेशी सरकार द्वारा खरीद में भाग लेने और / या प्रतिस्पर्धा करने की अनुमति नहीं है, जिसका भारतीय कंपनियों को प्रतिबंधित करने पर प्रत्यक्ष या अप्रत्यक्ष प्रभाव पड़ता है, जैसे कि प्रापण देश में पंजीकरण, प्रापण देश इत्यादि में विशिष्ट मूल्य की परियोजना का निष्पादन इत्यादि। यदि उपयुक्त समझा जाएगा तो उस देश के बोलीदाताओं को इस्पात मंत्रालय से संबंधित उस वस्तु तथा/ या अन्य वस्तुओं की खरीद के लिए पात्रता से प्रतिबंधित या अपवर्जित किया जा सकता है।</p> <p>6.9.5 ऊपर उप-पैरा 6.9.4 के प्रयोजन से, किसी आपूर्तिकर्ता या बोलीदाता को उस देश से माना जाएगा यदि (i) इकाई को उस देश में निगमित किया गया है, या (ii) उसकी शेयरधारिता या इकाई का प्रभावी नियंत्रण उस देश से किया जाता है; या (iii) आपूर्ति की जा रही वस्तु के मूल्य का 50% से अधिक उस देश में शामिल किया गया है। भारतीय आपूर्तिकर्ताओं का अर्थ उन संस्थाओं से होगा जो भारत के संबंध में इनमें से किसी भी मानदंड को पूरा करते हैं। किसी देश की 'इकाई' (एन्टिटी) शब्द का अर्थ वहीं होगा जो डीपीआईआईटी की एफडीआई नीति के तहत समय-समय पर यथा संशोधित के अंतर्गत है।</p>

3	<p>खंड 6.10 को खंड 6.9 के नीचे निम्नवत जोड़ा जाता है:</p> <p>खंड 6.10: यदि घरेलू आपूर्तिकर्ताओं के खिलाफ प्रतिबंधात्मक या भेदभावपूर्ण शर्तों को बोली दस्तावेजों में शामिल किया जाता है, तो उस के लिए जिम्मेदारी तय करने के लिए खरीद (इसके प्रशासनिक नियंत्रणाधीन किसी ईकाई द्वारा खरीद सहित) करने वाले प्रशासनिक विभाग द्वारा जांच शुरू की जाएगी। तत्पश्चात्, संबंधित प्रावधानों के तहत खरीद संस्थाओं के अधिकारियों के खिलाफ उचित, प्रशासनिक या अन्यथा कार्रवाई की जाएगी। ऐसी सभी कार्रवाई की सूचना डीएमआई और एसपी नीति के तहत स्थायी समिति को भेजी जाएगी।</p>
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संशोधित परिशिष्ट क - घरेलू स्तर पर निर्मित उत्पादों के लिए विशिष्ट रूप से

क्र. सं.	लौह एवं इस्पात उत्पादों की सांकेतिक सूची	लागू एच एस कोड	न्यूनतम घरेलू मूल्यवर्धन आवश्यकता
1	600 मि. मी. अथवा उससे अधिक की चौड़ाई वाले लौह अथवा गैर एलॉय इस्पात का फ्लेट रोल उत्पाद, हॉट रोल्ड, न ढका हुआ, प्लेट लगाया हुआ अथवा कोट किया हुआ	7208	50%
2	600 मि. मी. अथवा उससे अधिक की चौड़ाई वाले लौह अथवा गैर एलॉय इस्पात का फ्लेट रोल उत्पाद, कोल्ड रोल्ड (कोल्ड - कम किया हुआ), न ढका हुआ, प्लेट लगाया हुआ अथवा कोट किया हुआ	7209	50%
3	600 मि. मी. अथवा उससे अधिक की चौड़ाई वाले लौह अथवा गैर एलॉय इस्पात का फ्लेट रोल उत्पाद, ढका हुआ, प्लेट लगाया हुआ अथवा कोट किया हुआ	7210	50%
4	600 मि. मी. से कम की चौड़ाई वाले लौह अथवा गैर एलॉय इस्पात का फ्लेट रोल उत्पाद, न ढका हुआ, प्लेट लगाया हुआ अथवा कोट किया हुआ	7211	35%
5	600 मि. मी. कम की चौड़ाई का लौह अथवा गैर एलॉय इस्पात का फ्लेट रोल उत्पाद, ढका हुआ, प्लेट लगाया हुआ अथवा कोट किया हुआ	7212	35%
6	लौह एवं गैर एलॉय इस्पात का अनियमित रूप से ऎंठा हुआ क्वाइल में बार्स और रॉड, हॉट रोल्ड	7213	35%
7	लौह अथवा गैर एलॉय इस्पात के अन्य बार्स और रॉड्स जिसे फोर्ज किए जाने की तुलना में आगे अधिक वर्क नहीं किया हुआ, हॉट रोल्ड, हॉट ड्रॉन अथवा हॉट एक्सट्रूडेड परंतु रोलिंग के बाद उसे टिबिस्ट किये जाने सहित	7214	35%
8	लौह अथवा गैर एलॉय इस्पात का अन्य बार्स एंड रोड्स	7215	35%
9	लौह अथवा गैर एलॉय इस्पात का एंगल, शेष और सेक्शन्स	7216	35%
10	लौह अथवा गैर एलॉय इस्पात का तार	7217	50%
11	600 मि. मी. अथवा उससे अधिक की चौड़ाई का स्टेनलैस इस्पातका फ्लेट रोल्ड इस्पात	7219	50%
12	600 मि. मी. से कम की चौड़ाई का स्टेनलैस इस्पातका फ्लेट रोल्ड इस्पात	7220	50%
13	स्टेनलैस स्टील का अन्य बार्स और रोड्स; स्टेनलैस स्टील का एंगल शेष और सेक्शन्स	7222	50%
14	अन्य एलॉय इस्पात का तार	7229	35%
15	लौह अथवा इस्पात को रेल, रेलवे अथवा ट्रामवे ट्रेक निर्माण सामग्री	7302	50%

16	कास्ट लौह का ट्यूब, पाइप और होलो पाइप	7303	35%
17	लौह (कास्ट आयरन को छोड़कर) अथवा इस्पात का ट्यूब पाइप और होलो प्रोफाइल, सीमलैस	7304	35%
18	लौह अथवा इस्पात का सर्कुलर क्रॉस सेक्शन वाले अन्य ट्यूब और पाइप (उदाहरण के लिए, वेल्ड किया हुआ, रिबेट किया हुआ अथवा समान रूप से बंद किया गया हुआ), जिसकी बाहरी त्रिज्या 406.4 मि. मी. से अधिक हो	7305	35%
19	लौह अथवा इस्पात के अन्य ट्यूब, पाइप और होलो प्रोफाइल (उदाहरण के लिए ओपन सीन अथवा वेल्ड किया हुआ, रिबेट किया हुआ अथवा समान रूप से बंद किया गया हुआ)	7306	35%
20	लौह अथवा इस्पात का ट्यूब अथवा पाइप फिटिंग (उदाहरण के लिए, कनेक्टर/ कप्लिंग, एल्बो स्लीव्स)	7307	35%
21	स्टेनलैस स्टील का अनियमित रूप से ऎंठा हुआ क्वाइल में बार्स और रॉड, हॉट रोल्ड	7221	35%
22	स्टेनलैस स्टील का वायर	7223	35%
23	इलेक्ट्रिकल स्टील सहित 600 मि. मी. अथवा उससे अधिक की चौड़ाई वाले अन्य एलॉय स्टील का फ्लेट रोल्ड इस्पात	7225	35%
24	इलेक्ट्रिकल स्टील सहित 600 मि. मी. से कम की चौड़ाई वाले अन्य एलॉय स्टील का फ्लेट रोल्ड इस्पात	7226	35%
25	अन्य एलॉय स्टील का अनियमित रूप से ऎंठा हुआ क्वाइल में बार्स और रॉड, हॉट रोल्ड	7227	20%
26	अन्य एलॉय स्टील का अन्य बार्स और रॉड्स; अन्य एलॉय स्टील का एंगल, शेप्स और सेक्शन्स; एलॉय अथवा नॉन एलॉय स्टील का होलो ड्रिल बार्स और रॉड्स	7228	35%
27	लौह अथवा इस्पात की शीट पाइलिंग, चाहे ड्रिल किया हुआ हो अथवा नहीं, चाहे पंच किया हुआ हो अथवा नहीं, चाहे असेम्बल किये हुए तत्वों से बना हुआ हो अथवा नहीं; लौह अथवा इस्पात का वेल्ड किया हुआ एंगल, शेप और सेक्शन्स	7301	20%
28	स्ट्रक्चर्स (9406 के शीर्ष का प्रीफेब्रिकेटिड भवनों को छोड़कर) और स्ट्रक्चर्स का हिस्सा	7308	20%
29	300 से अधिक क्षमता का लौह अथवा इस्पात का किसी सामग्री (कम्प्रेस किए हुए अथवा सरलीकृत गैस को छोड़कर) के लिए भंडार, टैंक, वैट और समान कन्टेनर चाहे उसे लाइन किया गया हो अथवा नहीं या उसे हीट से इन्सुलेट किया गया हो अथवा नहीं लेकिन यांत्रिक अथवा तापीय उपक्रम से युक्त न हो	7309	20%
30	अधिकतम 300 लीटर की क्षमता का लौह अथवा इस्पात का किसी सामग्री (कम्प्रेस किए हुए अथवा सरलीकृत गैस को छोड़कर) के लिए टैंक, कास्ट, ड्रम, केन, बॉक्स और समान कन्टेनर चाहे उसे लाइन किया गया हो अथवा नहीं या उसे हीट से इन्सुलेट किया गया हो अथवा नहीं लेकिन यांत्रिक अथवा तापीय उपक्रम से युक्त न हो	7310	20%
31	लौह अथवा इस्पात का कम्प्रेस किया हुआ अथवा सरलीकृत गैस के लिए कन्टेनर	7311	20%

32	लौह अथवा इस्पात का स्टैंडिड वायर, रोप, केबल, प्लेटिड बैंड, स्लिंग और उसके समान वस्तु जिसे विद्युतीय रूप से इन्सुलेट न किया गया	7312	20%
33	लौह अथवा इस्पात का फेनसिंग के लिए उपयोग किये जाने वाला बार किया हुआ वायर; ट्विस्ट किया हुआ हूप अथवा सिंगल फ्लेट वायर, बार्स किया हुआ अथवा नहीं और लूज तरीके से ट्विस्ट किया हुआ डबल वायर	7313	20%
34	लौह अथवा इस्पात तार का ड्रील, नेटिंग और फेनसिंग; लौह अथवा इस्पात का विस्तार किया हुआ धातु	7314	20%
35	लौह अथवा इस्पात का चैन और उसका हिस्सा	7315	20%
36	लौह अथवा इस्पात का टैंकर, ग्रेपनेल्स और उसका हिस्सा	7316	20%
37	लौह एवं इस्पात की वस्तुएं	7317	20%
38	लौह एवं इस्पात की वस्तुएं	7318	20%
39	लौह एवं इस्पात की वस्तुएं	7319	20%
40	लौह अथवा इस्पात का स्प्रिंग और स्प्रिंग के लिए लीव्स	7320	20%
41	लौह अथवा इस्पात का स्टोव्स, रेंज, ग्रेड, कूकर (केंद्रीय हिटिंग के लिए सहायक बायलरों के साथ उन वस्तुओं सहित), बारबेक्यूज, ब्रेजियर्स, गैस रिंग, प्लेट वामर्स और समान गैर-विद्युतीय घरेलू उपकरण और उसका हिस्सा	7321	20%
42	लौह अथवा इस्पात का केंद्रीय हिटिंग के लिए रेडियेटर जिसे विद्युतीय रूप से हीट न किया गया हो और उसका हिस्सा; लौह अथवा इस्पात का हेयर हीटर और हॉट एयर वितरक जिसे विद्युतीय रूप से हीट न किया गया हो, फेन अथवा ब्लोअर जो मोटर से चलती हो और उसके हिस्से को शामिल करते हुए	7322	20%
43	लौह अथवा इस्पात का टेबल और समान घरेलू वस्तुएं और उसका हिस्सा	7323	20%
44	लौह अथवा इस्पात का सेनेटरी वेयर और उसकेपार्ट्स	7324	20%
45	लौह अथवा इस्पात का अन्य कास्ट सामान	7325	20%
46	लौह अथवा इस्पात का विद्युतीय इस्पात और अन्य वस्तु	7326	20%
47	रेलवे अथवा ट्रामवे पेसेंजर कोच जो स्वयं आगे नहीं बढ़ता हो	8605	50%
48	रेलवे अथवा ट्रामवे माल वेन और वेगेन जो स्वयं आगे नहीं बढ़ता हो	8606	50%
49	रेलवे अथवा ट्रामवे लोकोमोटिव का हिस्सा अथवा रोलिंग स्टॉक जैसे बोगिज, बिसल बोगिज, एक्सेल और फोज्ड किया हुआ पहिया और उसका हिस्सा	8607	50%

विवरणों में शामिल किए गए उत्पाद सांकेतिक हैं; विनिर्दिष्ट एच एस कोड के अंतर्गत सभी उत्पादों को परिशिष्ट के भाग के रूप में शामिल किया गया है।"

[फा. सं. एस-13026/1/2020-आईडीडी]

रसिका चौबे, अपर सचिव

**MINISTRY OF STEEL
NOTIFICATION**

New Delhi, the 31st December, 2020

G.S.R. 1(E).—The amendments in the Policy for providing preference to domestically manufactured Iron & Steel products in Government procurement (DMI&SP Policy)—Revised, 2019 is hereby published for general information.

"No. S-13026/1/2020- IDD

Ministry of Steel

ID Division

Udyog Bhawan,

New Delhi 31st December, 2020

Sub.: Amendments / additions to the Policy for Providing Preference to Domestically Manufactured Iron & Steel Products in Government Procurement - revised, 2019

The following amendments / additions to the Policy for Providing Preference to Domestically Manufactured Iron & Steel Products in Government Procurement - revised, 2019 (DMI&SP revised, 2019) are applicable with immediate effect. These amendments / additions shall not apply to any tender or procurement for which notice inviting tender or other form of procurement solicitation has been issued before the issue of this notification.

I - Amendments: Table 1

Sl. No.	Existing Clause in DMI&SP revised, 2019	Amended Clause in DMI&SP revised, 2019
1	<p>Clause 1.3: The policy is applicable to every Ministry or Department of Government and all agencies/entities under their administrative control and to projects funded by these agencies for purchase of iron & steel products for government projects. However, this policy shall not apply for purchase of iron & steel products with a view to commercial resale or with a view to use in the production of goods for commercial sale.</p>	<p>Clause 1.3: The policy is applicable to every Ministry or Department of Government and all agencies/entities under their administrative control and to projects funded by these agencies for purchase of iron & steel products for government projects. <u>All Central Sector Schemes (CS)/Centrally Sponsored Schemes (CSS) for which procurement is made by States and Local Bodies, would come within the purview of this Policy, if that project / scheme is fully / partly funded by Government of India.</u> However, this policy shall not apply for purchase of iron & steel products with a view to commercial resale or with a view to use in the production of goods for commercial sale.</p>
2	<p>Clause 2.13: Domestic value addition shall be the net selling price (invoiced price excluding net domestic taxes and duties) minus the landed cost of imported input materials at the manufacturing plant in India (including all customs duties) as a proportion of the net selling price, in percent. The 'domestic value addition' definition shall be in line with the DPIIT (formerly DIPP) guidelines, and shall be suitably amended in case of any changes by DPIIT in the future. For the purpose of this policy document, domestic value addition and local content have been used interchangeably.</p>	<p>Clause 2.13: Domestic value addition means - <u>amount of value added in India which shall be the total value of the item to be procured / sold (excluding net domestic indirect taxes) minus the value of imported content in the item (including all customs duties) as a proportion of the total value of the item to be procured / sold, in percent.</u> The 'domestic value addition' definition shall be in line with the DPIIT (formerly DIPP) guidelines, and shall be suitably amended in case of any changes by DPIIT in the future. For the purpose of this policy document, domestic value addition and local content have been used interchangeably.</p>

3	<p>Clause 5.1.5 The policy is applicable to all projects funded by Ministry or Department of Government and all agencies/ entities under their administrative control for purchase of iron & steel products.</p>	<p>Clause 5.1.5: The policy is applicable to all projects funded by Ministry or Department of Government and all agencies/ entities under their administrative control for purchase of iron & steel products. <u>All Central Sector Schemes (CS)/Centrally Sponsored Schemes (CSS) for which procurement is made by States and Local Bodies, would come within the purview of this Policy, if that project / scheme is fully / partly funded by Government of India.</u></p>
4	<p>Clause 5.1.6: The policy shall be applicable to projects where the procurement value of iron and steel products is greater than Rs. 25 crores. The policy shall also be applicable for other procurement (non-project), where annual procurement value of iron and steel products for that Government organization is greater than Rs. 25 crores.</p>	<p>Clause 5.1.6 The policy shall be applicable to projects where the procurement value of iron and steel products (Appendix - A of the DMI&SP Policy) is greater than Rs. 5 lakhs. The policy shall also be applicable for other procurements (non-project), where annual procurement value of iron and steel products for that Government organization is greater than Rs. 5 lakhs. However, it shall be ensured by procuring entities that procurement is not split for the purpose of avoiding the provisions of this policy.</p>
5	<p>Clause 7.2: Domestic value addition shall be the net selling price (invoiced price excluding net domestic taxes and duties) minus the landed cost of imported input materials at the manufacturing plant in India (including all customs duties) as a proportion of the net selling price, in per cent.</p>	<p>Clause 7.2: Domestic value addition means - amount of value added in India which shall be the total value of the item to be procured / sold (excluding net domestic indirect taxes) minus the value of imported content in the item (including all customs duties) as a proportion of the total value of the item to be procured / sold, in percent.</p>
6	<p>Clause 7.3: It is recommended that each bidder participating in the tender process should calculate the domestic value addition using the below formula below so as to ensure the domestic value addition claimed is consistent with the minimum stipulated domestic value addition requirement of the policy.</p> <p>For iron and steel products</p> <p>% domestic value addition</p> <p><i>Net selling price of final product - landed cost of imported iron or steel at the plant-----</i> <i>----- X 100 %</i></p> <p><i>Net selling price of final product</i></p> <p>For capital goods</p> <p>% domestic value addition</p> <p><i>Net selling price of final product - landed cost of imported iron or steel at the plant</i> <i>----- X 100 %</i></p> <p><i>Net selling price of final product</i></p>	<p>Clause 7.3: It is recommended that procuring Government agency / bidder participating in the tender process should calculate the domestic value addition using the below formula so as to ensure that the domestic value addition claimed is consistent with the minimum stipulated domestic value addition requirement of the policy.</p> <p>For iron and steel products & capital goods</p> <p>% domestic value addition</p> <p><i>Total value of the item to be procured / sold (excluding net domestic indirect taxes) - the value of imported content in the item (including all customs duties)</i> <i>----- X 100 %</i></p> <p><i>Total value of the item to be procured / sold</i></p>

II - Following amendment is made to the Appendix A of the DMI&SP revised, 2019 :- Wherever minimum domestic value addition of **15%** is specified in the Appendix - A of the DMI&SP revised, 2019 under the column Minimum domestic value addition requirement, same shall be replaced with **20%** minimum domestic value addition). (Revised Appendix - A is attached)

III - Additions / Insertions: Table 2

Sl. No.	Added / Inserted Clause in DMI&SP revised, 2019
1	<p>Clause 5.1.13 is inserted below Clause 5.1.12 as:</p> <p>Clause 5.1.13: No Global Tender Enquiry (GTE) shall be invited for tenders related to procurement of iron and steel products (Appendix-A of the DMI&SP Policy). No Global Tender Enquiry (GTE) shall be invited for tenders related to procurement of Capital Goods for manufacturing iron & steel products (Appendix- B of the DMI&SP Policy) having estimated value upto Rs. 200 Crore except with the approval of competent authority as designated by Department of Expenditure.</p>
2	<p>Clause 6.9 is inserted below Clause 6.8 as:</p> <p>Clause 6.9: Specifications in Tenders and other procurement solicitations:</p> <p>6.9.1 Every procuring entity shall ensure that the eligibility conditions in respect of previous experience fixed in any tender or solicitation do not require proof of supply in other countries or proof of exports.</p> <p>6.9.2 Procuring entities shall endeavour to see that eligibility conditions, including on matters like turnover, production capability and financial strength do not result in unreasonable exclusion of local supplier' who would otherwise be eligible, beyond what is essential for ensuring quality or creditworthiness of the supplier.</p> <p>6.9.3 Procuring entities shall, within 2 months of the issue of this policy review all existing eligibility norms and conditions with reference to sub-paragraphs 6.9.1 and 6.9.2 above.</p> <p>6.9.4 If Ministry of Steel is satisfied that Indian suppliers of iron and steel products are not allowed to participate and/ or compete in procurement by any foreign government due to restrictive tender conditions which have direct or indirect effect of barring Indian companies such as registration in the procuring country, execution of project of specific value in the procuring country etc., it may, if deemed appropriate, restrict or exclude bidders from that country from eligibility for procurement of that item and/ or other items relating to Ministry of Steel.</p> <p>6.9.5 For the purpose of sub-paragraph 6.9.4 above, a supplier or bidder shall be considered to be from a country if (i) the entity is incorporated in that country, or (ii) a majority of its shareholding or effective control of the entity is exercised from that country; or (iii) more than 50% of the value of the item being supplied has been added in that country. Indian suppliers shall mean those entities which meet any of these tests with respect to India. The term 'entity' of a country shall have the same meaning as under the FDI Policy of DPIIT as amended from time to time.</p>
3	<p>Clause 6.10 is inserted below Clause 6.9 as:</p> <p>Clause 6.10: In case restrictive or discriminatory conditions against domestic suppliers are included in bid documents, an inquiry shall be conducted by the Administrative Department undertaking the procurement (including procurement by any entity under its administrative control) to fix responsibility for same. Thereafter, appropriate action, administrative or otherwise, shall be taken against erring officials of procurement entities under relevant provisions. Intimation on all such action shall be sent to the Standing Committee under the DMI&SP Policy.</p>

IV - Revised Appendix A - Exclusive for domestically manufactured products

Sl. No	Indicative list of Iron & Steel Products	Applicable HS code	Minimum domestic value addition requirement
1	Flat-rolled products of iron or non alloy steel, of a width of 600 mm or more, hot rolled, not clad, plated or coated	7208	50%
2	Flat-rolled products of iron or non alloy steel, of a width of 600	7209	50%

	mm or more, cold rolled (cold-reduced), not clad, plated or coated		
3	Flat-rolled products of iron or non alloy steel, of a width of 600 mm or more, clad, plated or coated	7210	50%
4	Flat-rolled products of iron or non alloy steel, of a width of less than 600 mm, not clad, plated or coated	7211	35%
5	Flat-rolled products of iron or non alloy steel, of a width of less than 600 mm, clad, plated or coated	7212	35%
6	Bars and rods, hot-rolled, in irregularly wound coils, of iron or non-alloy steel	7213	35%
7	Other bars and rods of iron or non alloy steel, not further worked than forged, hot rolled, hot-drawn or hot-extruded, but including those twisted after rolling	7214	35%
8	Other bars and rods of iron or non alloy steel	7215	35%
9	Angles, shapes and sections of iron or non-alloy steel	7216	35%
10	Wire of iron or non-alloy steel	7217	50%
11	Flat-rolled products of stainless steel, of a width of 600 mm or more	7219	50%
12	Flat-rolled products of stainless steel, of a width of less than 600 mm	7220	50%
13	Other bars and rods of stainless steel; angles, shapes and sections of stainless steel	7222	50%
14	Wire of other alloy steel	7229	35%
15	Rails, railway or tramway track construction material of iron or steel	7302	50%
16	Tubes, pipes and hollow profiles, of cast iron	7303	35%
17	Tubes, pipes and hollow profiles, seamless, of iron (other than cast iron) or steel	7304	35%
18	Other tubes and pipes (for example, welded, riveted or similarly closed), having circular cross-sections, the external diameter of which exceeds 406.4 mm, of iron or steel	7305	35%
19	Other tubes, pipes and hollow profiles (for example, open seam or welded, riveted or similarly closed), of iron or steel	7306	35%
20	Tube or pipe fittings (for example, connectors/couplings, elbow sleeves), of iron or steel	7307	35%
21	Bars and rods, hot-rolled, in irregularly wound coils, of stainless steel	7221	35%
22	Wire of stainless steel	7223	35%
23	Flat-rolled products of other alloy steel, of a width of 600 mm or more, including electrical steel	7225	35%
24	Flat-rolled products of other alloy steel, of a width of less than 600 mm, including electrical steel	7226	35%
25	Bars and rods, hot-rolled, in irregularly wound coils, of other alloy steel	7227	20%

26	Other bars and rods of other alloy steel; angles, shapes and sections, of other alloy steel; hollow drill bars and rods, of alloy or nonalloy steel	7228	35%
27	Sheet piling of iron or steel, whether or not drilled, punched or made from assembled elements; welded angles, shapes and sections, of iron or steel	7301	20%
28	Structures (excluding prefabricated buildings of heading 9406) and parts of structures	7308	20%
29	Reservoirs, tanks, vats and similar containers for any material (other than compressed or liquefied gas), of iron or steel, of a capacity exceeding 300 whether or not lined or heatinsulated, but not fitted with mechanical or Thermal equipment	7309	20%
30	Tanks, casks, drums, cans, boxes and similar containers, for any material (other than compressed or liquefied gas), of iron or steel, of a capacity not exceeding 300 L, whether or not lined or heat-insulated, but not fitted with mechanical or thermal equipment	7310	20%
31	Containers for compressed or liquefied gas, of iron or steel	7311	20%
32	Stranded wire, ropes, cables, plaited bands, slings and the like, of iron or steel, not electrically insulated	7312	20%
33	Barbed wire of iron or steel; twisted hoop or single flat wire, barbed or not, and loosely twisted double wire, of a kind used for fencing, of iron or steel	7313	20%
34	Grill, netting and fencing, of iron or steel wire; expanded metal of iron or steel	7314	20%
35	Chain and parts thereof, of iron or steel	7315	20%
36	Anchors, grapnels and parts thereof, of iron or steel	7316	20%
37	Articles of iron and steel	7317	20%
38	Articles of iron and steel	7318	20%
39	Articles of iron and steel	7319	20%
40	Springs and leaves for springs, of iron or steel	7320	20%
41	Stoves, ranges, grates, cookers (including those with subsidiary boilers for central heating), barbecues, braziers, gas-rings, plate warmers and similar non-electric domestic appliances, and parts thereof, of iron or steel	7321	20%
42	Radiators for central heating, not electrically heated, and parts thereof, of iron or steel; air heaters and hot air distributors, not electrically heated, incorporating a motor-driven fan or blower, and parts thereof, of iron or steel	7322	20%
43	Tables and similar household articles and parts thereof, of iron or steel	7323	20%
44	Sanitary ware and parts thereof, of iron or steel	7324	20%
45	Other cast articles of iron or steel	7325	20%

46	Electrical steel and other articles of iron or steel	7326	20%
47	Railway or tramway passenger coaches, not self-propelled	8605	50%
48	Railway or tramway goods vans and wagons, not self-propelled	8606	50%
49	Parts of railway or tramway locomotives or rolling-stock, such as bogies, bissel-bogies, axles and forged wheels, and parts thereof	8607	50%

Products included in descriptions are indicative; all products under the specified HS codes are included as part of the appendix."

[F. No. S-13026/1/2020-IDD]
RASIKA CHAUBE, Addl. Secy.

**POLICY FOR PROVIDING PREFERENCE TO DOMESTICALLY MANUFACTURED IRON
& STEEL PRODUCTS IN GOVERNMENT PROCUREMENT (TO BE SUBMITTED ON BIDDER'S
LETTERHEAD) SELF-CERTIFICATE**

To,
M/s Talcher Fertilizers Limited

SUB:
TENDER NO:

Dear Sir,

This has reference to "Policy for providing Preference to Domestically Manufactured Iron & Steel Products in Government Procurement" issued by Ministry of Steel, Govt. of India, vide their revised notification "The Gazette of India, Notification No. 385 (E) dated 29.05.2019".

We confirm that we will obtain Affidavit of Self Certification of Domestic value addition in Iron & Steel Products from manufacturer before supply of iron and steel products required under the tender/bidding document.

Sign & Stamp of bidder

SECTION-III

INSTRUCTION TO BIDDERS

**[TO BE READ IN CONJUNCTION WITH BIDDING DATA
SHEET (BDS)]**

SECTION-III

INSTRUCTION TO BIDDERS

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INSTRUCTION TO BIDDERS [ITB]

(TO BE READ IN CONJUNCTION WITH BIDDING DATA SHEET (BDS))

[A] – GENERAL

1 SCOPE OF BID

- 1.1 The Employer as defined in the "General Conditions of Contract [GCC]", wishes to receive Bids as described in the Invitation For Bid (the “**Tender Document /Bid Document**”) issued by Employer. Employer/Owner/TFL occurring herein under shall be considered synonymous.
- 1.2 SCOPE OF BID: The scope of work/ Services shall be as defined in Section-VI of the Tender documents.
- 1.3 The successful bidder will be expected to complete the scope of Bid within the period stated in Special Conditions of Contract.
- 1.4 Throughout the Tender Documents, the terms 'Bid', 'Tender' & 'Offer' and their derivatives [Bidder/Tenderer, Bid/Tender/Offer etc.] are synonymous. Further, 'Day' means 'Calendar Day' and 'Singular' also means 'Plural'.

2 ELIGIBLE BIDDERS

- 2.1 Provision for procurement from a bidder which shares a land border with India has been attached as **Annexure-VII** herewith.
- 2.2 The Bidder shall not be under a declaration of ineligibility by Employer for Corrupt/ Fraudulent/ Collusive/ Coercive practices, as defined in "Instructions to Bidders [ITB], Clause No. 39" (Action in case Corrupt/ Fraudulent/ Collusive/ Coercive Practices).
- 2.3 The Bidder is not put on 'Holiday' by TFL or any of the JV partner of OWNER (viz. GAIL, RCF, CIL) or Public-Sector Project Management Consultant (like PDIL,EIL, MECON only due to “poor performance” or “corrupt and fraudulent practices”) or banned/blacklisted by Government department/ Public Sector on due date of submission of bid. Further, neither bidder nor their allied agency/(ies) (as defined in the Procedure for Action in case of Corrupt/Fraudulent/Collusive/ Coercive Practices)are on banning list of TFL or any of the JV partner of OWNER viz. GAIL, RCF, CIL.

If the Bidding documents were issued inadvertently/ downloaded from website, offers submitted by such bidders shall not be considered for opening/ evaluation/Award and will be returned immediately to such bidders.

In case there is any change in status of the declaration prior to award of contract, the same has to be promptly informed to TFL/PDIL by the bidder.

It shall be the sole responsibility of the bidder to inform about their status regarding para 1 of clause 2.2 herein above on due date of submission of bid and during the course of finalization of the tender. Concealment of the facts shall tantamount to misrepresentation of facts and shall lead to action against such Bidders as per clause 39 of ITB.

2.4 The Bidder should not be under any liquidation court receivership or similar proceedings on due date of submission of bid. In case there is any change in status of the declaration prior to award of contract, the same has to be promptly informed to TFL/PDIL by the bidder.

It shall be the sole responsibility of the bidder to inform TFL there status on above on due date of submission of bid and during the course of finalization of the tender. Concealment of the facts shall tantamount to misrepresentation of facts and shall lead to action against such Bidders as per clause no. 39 of ITB.

2.5 Bidder shall not be affiliated with a firm or entity:

- (i) that has provided consulting services related to the work to the Employer during the preparatory stages of the work or of the project of which the works/services forms a part of or
- (ii) that has been hired (proposed to be hired) by the Employer as an Engineer/ Consultant for the contract.

2.6 Neither the firm/entity appointed as the Project Management Consultant (PMC) for a contract nor its affiliates/ JV'S/ Subsidiaries shall be allowed to participate in the tendering process unless it is the sole Licensor/Licensor nominated agent/ vendor.

2.7 Pursuant to qualification criteria set forth in the bidding document, the Bidder shall furnish all necessary supporting documentary evidence to establish Bidder's claim of meeting qualification criteria.

2.8 **Power of Attorney:**

Power of Attorney (PoA) to be issued by the bidder in favour of the authorised employee(s), in respect of the particular tender, for purpose of signing the documents including bid, all subsequent communications, agreements, documents etc. pertaining to the tender and act and take any and all decision on behalf of the bidder (including Consortium). Any consequence resulting due to such signing shall be binding on the Bidder (including Consortium).

(I) In case of a Single Bidder, the Power of Attorney shall be issued as per the constitution of the bidder as below:

- a) **In case of Proprietorship:** By Proprietor
- b) **In case of Partnership:** by all Partners or Managing Partner.
- c) **In case of Limited Liability Partnership:** by any bidder's employee authorized in terms of Deed of LLP.
- d) **In case of Public /Limited Company:** PoA in favour of authorized employee(s) by Board of Directors through Board Resolution or by the designated officer authorized by Board to do so. Such Board Resolution should be duly countersigned by Company Secretary / MD / CMD / CEO.

The Power of Attorney should be valid till award of contract/order to successful bidder.

(II) In case of a Consortium, Power of Attorney shall be issued both by Leader as well as Consortium Member(s) of the Consortium as per procedure defined herein above in favour of employee of Leader of Consortium.

3 BIDS FROM "CONSORTIUM"/"JOINT VENTURES"

Applicable for this tender.

4 ONE BID PER BIDDER

4.1 A Bidder shall submit only 'one [01] Bid' in the same Bidding Process either as single entity or as a member of any consortium (wherever consortium bid is allowed). A Bidder who submits or participates in more than 'one [01] Bid' will cause all the proposals in which the Bidder has participated to be disqualified.

4.2 A bidder shall not have conflict of interest with other bidders. Such conflict of interest can lead to anti-competitive practices. The bidder found to have a conflict of interest shall be disqualified. A bidder shall be considered to have a conflict of interest with one or more bidders in this bidding process, if:

- a) they have controlling partner (s) in common; or
- b) they receive or have received any direct or indirect subsidy/ financial stake from any of them; or
- c) they have the same legal representative/authorized signatory/agent for purposes of this bid; or
- d) they have relationship with each other, directly or through common third parties, that puts them in a position to have access to information about or influence on the bid of another Bidder; or
- e) Bidder participates in more than one bid in bidding process. Participation by a Bidder in more than one Bid will result in the disqualification of all bids in which the parties are involved. However, this does not limit the inclusion of the components/ sub-assembly/ Assemblies from one bidding manufacturer in more than one bid.
- f) a Bidder or any of its affiliates participated as a consultant in the preparation of the design or technical specifications of the contract that is the subject of the Bid;
- g) In case of a holding company having more than one independently manufacturing units, or more than one unit having common business ownership/management, only one unit should quote. Similar restrictions would apply to closely related sister companies. Bidders must proactively declare such sister/ common business/ management units in same/ similar line of business.

Failure to comply this clause during tendering process will disqualify all such bidders from process of evaluation of bids.

4.3 Alternative Bids shall not be considered.

4.4 The provisions mentioned at sl. no. 4.1 and 4.2 shall not be applicable wherein bidders are quoting for different Items / Sections / Parts / Groups/ SOR items of the same tender which specifies evaluation on Items / Sections / Parts / Groups/ SOR items basis.

5 COST OF BIDDING

The Bidder shall bear all costs associated with the preparation and submission of the Bid including but not limited to Documentation Charges, Bank charges all courier charges translation charges, authentication charges and any associated charges including taxes & duties thereon. Further, TFL/PDIL will in no case, be responsible or liable for these costs, regardless of the outcome of the bidding process.

6 SITE VISIT

- 6.1 The Bidder is advised to visit and examine the site of works and its surroundings and obtain for itself on its own responsibility all information that may be necessary for preparing the Bid and entering into a Contract for the required job. The costs of visiting the site shall be borne by the Bidder.
- 6.2 The Bidder or any of its personnel or agents shall be granted permission by the Employer to enter upon its premises and land for the purpose of such visits, but only upon the express conditions that the Bidder, its personnel and agents will release and indemnify the Employer and its personnel, agents from and against all liabilities in respect thereof, and will be responsible for death or injury, loss or damage to property, and any other loss, damage, costs, and expenses incurred as a result of inspection.
- 6.3 The Bidder shall not be entitled to hold any claim against TALCHER FERTILIZERS LIMITED for non-compliance due to lack of any kind of pre-requisite information as it is the sole responsibility of the Bidder to obtain all the necessary information with regard to site, surrounding, working conditions, weather etc. on its own before submission of the bid.

[B] –BIDDING DOCUMENTS

7 CONTENTS OF BIDDING DOCUMENTS

- 7.1 The contents of Bidding Documents /Tender documents are those stated below, and should be read in conjunction with any 'Addendum / Corrigendum and Clarification(s)' issued in accordance with "ITB: Clause-8 & 9":

- Section-I : Invitation for Bid [IFB]
- Section-II : BID EVALUATION CRITERIA [BEC] & Evaluation methodology
- Section-III : Instructions to Bidders [ITB], Annexure, Forms & Formats
- Section-IV : General Conditions of Contract [GCC]
- Section-V : Special Conditions of Contract [SCC]
- Section-VI : Scope of Work & Technical Specifications
- Section-VII : Price Schedule/ Schedule of Rates

*'Request for Quotation', wherever applicable, shall also form part of the Bidding document.

For participation in e-tender, instructions are mentioned at Annexure-III to Section-III of tender.

- 7.2 The Bidder is expected to examine all instructions, forms, terms & conditions in the Bidding Documents. The "Request for Quotation [RFQ] & Invitation for Bid (IFB)" together with all its attachments thereto, shall be considered to be read, understood and accepted by the Bidders. Failure to furnish all information required by the Bidding Documents or submission of a Bid not substantially responsive to the Bidding Documents in every respect will be at Bidder's risk and may result in the rejection of his Bid.

8 CLARIFICATION OF TENDER DOCUMENTS

- 8.1 A prospective Bidder requiring any clarification(s) of the Bidding Documents may notify TFL in writing or through CPP Portal (<https://eprocure.gov.in/eprocure/app>) or email at PDIL's mailing address indicated in the BDS no later than 02 (two) days prior to pre-bid meeting (in cases where pre-bid meeting is scheduled) or 05 (five) days prior to the due date of submission of bid in cases where pre-bid meeting is not scheduled. TFL/PDIL reserves the right to ignore the bidders request for clarification if received after the aforesaid period. TFL/PDIL may respond in writing to the request for clarification. TFL/PDIL's response including an explanation of the query, but without identifying the source of the query will be uploaded on the websites mentioned at Clause No. 2.0 (G) of IFB. Hence, bidders are requested to regularly visit the said websites for updates.
- 8.2 Any clarification or information required by the Bidder but same not received by the Employer at clause 8.1 (refer BDS for address) above is liable to be considered as "no clarification / information required".

9 AMENDMENT OF BIDDING DOCUMENTS

- 9.1 At any time prior to the 'Bid Due Date', Employer for any reason, whether at its own initiative or in response to a clarification requested by a prospective Bidder, modify the Bidding Documents by addenda / corrigendum.
- 9.2 Any corrigendum thus issued shall be integral part of the Tender Document and shall be hosted only on the websites as provided at clause no. 2.0 (G) of IFB. Bidders, in their own interest, are advised to regularly check the websites for any amendment/Corrigendum/Addendum. Bidders have to take into account all such amendment / corrigendum before submitting their Bid. TFL/PDIL will not take any responsibility or entertain any representation whatsoever, in case bidders have not checked/seen/downloaded such amendment/Corrigendum/Addendum or reply to pre-bid queries uploaded on the said websites.
- 9.3 The Employer, if it considers necessary, may extend the Bid Due Date in order to allow the Bidders a reasonable time to furnish their most competitive bid taking into account the addenda / corrigendum issued thereof.
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[C] – PREPARATION OF BIDS

10 LANGUAGE OF BID:

The bid prepared by the Bidder and all correspondence, drawing(s), document(s), certificate(s) etc. relating to the Bid exchanged by Bidder and TFL shall be written in English language only. In case a document, certificate, printed literature etc. furnished by the Bidder in a language other than English, the same should be accompanied by an English translation duly authenticated by the Indian Chamber of Commerce , in which case, for the purpose of interpretation of the Bid, the English translation shall govern.

11. DOCUMENTS COMPRISING THE BID

11.1 Bidders are requested to refer instructions for participating in e-Tendering (Annexure-I to Section III of tender), Ready Reckoner for Bidders and FAQs available in e-portal and bids submitted manually shall be rejected. All pages of the Bid must be digitally signed by the "authorized signatory" of the Bidder holding Power of Attorney. The bids must be submitted on e-tendering website of CPP portal (<https://eprocure.gov.in/eprocure/app>) comprising following documents:-

11.1.1 **PART-I: "TECHNO-COMMERCIAL / UN-PRICED BID"** shall contain the following:

- (a) 'Covering Letter' on Bidder's 'Letterhead' clearly specifying the enclosed Contents with index
- (b) 'Bidder's General Information', as per 'Form F-1'.
- (c) Copies of documents, as specified in tender document
- (d) Copy of Schedule of Rates (SOR) with prices blanked out mentioning quoted / not quoted (as applicable) written against each item as a confirmation that the prices are quoted in requisite format .
- (e) 'Letter of Authority' on the Letter Head, as per 'Form F-3'
- (f) 'Agreed Terms and Conditions', as per 'Form F-5'
- (g) 'ACKNOWLEDGEMENT CUM CONSENT LETTER', as per 'Form F-6'
- (h) Duly attested documents in accordance with the "BID EVALUATION CRITERIA [BEC]" establishing the qualification.
- (i) Copy of Power of Attorney as per 'F-20'/copy of Board Resolution, in favour of the authorized signatory of the Bid, as per clause no. 2.8 of ITB (Original to be submitted physically).
- (j) Copy of EMD / Declaration for Bid Security in original as per Clause 16 of ITB (Original to be submitted physically)
- (k) Undertaking as per Form-I to Annexure-V to Section-III and Certification from the statutory auditor or cost auditor of the company (in the case of companies) or from a practicing cost accountant or practicing chartered accountant (in respect of other than companies) as per Form-II to Annexure-V to Section-III (Applicable for all bidders irrespective of seeking purchase preference or not).
- (l) Undertaking as per Form-I to Annexure VII regarding Provisions for Procurement from a bidder which shares a land border with India.
- (m) All forms and Formats including Annexures
- (n) 'Integrity Pact' as per 'Form F-14'
- (o) 'Indemnity Bond' as per 'Form F-15'

- (p) Checklist for Bid Evaluation Criteria (BEC) qualifying documents for bidder as per 'Form F-8A & F-8B
- (q) Tender Document, its Corrigendum/Amendment/Clarification(s) duly signed on each page (in case of manual tendering)/ digitally signed (in case of e-Tender) by the Authorized Signatory holding POA.
- (r) Additional document specified in BDS, SCC, Scope of Supply or mentioned elsewhere in the Tender Document, its Corrigendum/Amendment/Clarification(s).
- (s) Any other information/details required as per Tender Document

Note:

1. All the pages of the Bid must be signed/ digitally signed by the "Authorized Signatory" of the Bidder holding POA.

11.1.2 PART-II: Price Bid

The Prices are to be filled strictly in the Schedule of Rate of the bidding documents and provision mentioned at para 11.1.2 hereinabove and to uploaded in SOR attachment/Conditions of CPP portal.

- 11.2 "TECHNO-COMMERCIAL/UN-PRICED BID" comprising all the above documents mentioned at 11.1.1 along with copy of EMD/Bid Security, copy of Power of Attorney and copy of integrity pact should be uploaded in the CPP portal. Further, Bidders must submit the original " EMD, Power of Attorney, Integrity Pact (wherever applicable) and any other documents specified in the Tender Document to the address mentioned in IFB, in a sealed envelope, superscribing the details of Tender Document (i.e. tender number & tender for) within 7 days from the date of un-priced bid opening.

Bidders are required to submit the EMD in original by Due Date and Time of Bid Submission or upload a scanned copy of the same in the Part-I of the Bid. If the Bidder is unable to submit EMD in original by Due Date and Time of Bid Submission, the Bidder is required to upload a scanned copy of the EMD in Part-I of Bid, provided the original EMD, copy of which has been uploaded, is received within 7 days from the Due Date of Bid Opening, failing which the Bid will be rejected irrespective of their status/ranking in tendering process and notwithstanding the fact that a copy of EMD was earlier uploaded by the Bidder.

- 11.3 In case of bids invited under *single bid system*, a single envelope containing all documents specified at Clause 11.1.1 & 11.1.2 of ITB above form the BID. All corresponding conditions specified at Clause 11.1.1 & 11.1.2 of ITB shall become applicable in such a case.

12 BID PRICES

- 12.1 Unless stated otherwise in the Bidding Documents, the Contract shall be for the whole works as described in Bidding Documents, based on the rates and prices submitted by the Bidder and accepted by the Employer. The prices quoted by the Bidders will be inclusive of all taxes except **GST (CGST & SGST/UTGST or IGST)**. Applicable rate of **GST (CGST & SGST/ UTGST or IGST)** on the contract value shall be indicated in SOR under column for GST.

- 12.2 Prices must be filled in format for "Schedule of Rates [SOR] " enclosed as part of Tender document. If quoted in separate typed sheets and any variation in item description, unit or quantity is noticed; the Bid is liable to be rejected.

- 12.3 Bidder shall quote for all the items of "SOR" after careful analysis of cost involved for the performance of the completed item considering all parts of the Bidding Document. In case any activity though specifically not covered in description of item under "SOR" but is required to complete the works as per Specifications, Scope of Work / Service, Standards, General Conditions of Contract ("GCC"), Special Conditions of Contract ("SCC") or any other part of Bidding Document, the prices quoted shall be deemed to be inclusive of cost incurred for such activity.
- 12.4 All duties, taxes and other levies [if any] payable by the Contractor under the Contract, or for any other cause except final **GST (CGST & SGST/ UTGST or IGST)** shall be included in the rates / prices and the total bid-price submitted by the Bidder.
- 12.5 Prices quoted by the Bidder, shall remain firm and fixed and valid till completion of the Contract and will not be subject to variation on any account unless any price escalation/variation is allowed elsewhere in Tender Document.
- 12.6 Bidder shall also mention the **Service Accounting Codes (SAC) / Harmonized System of Nomenclature (HSN)** at the designated place in Techno-Commercial / Un-Priced bid.

13 GST (CGST & SGST/ UTGST or IGST)

- 13.1 Bidders are required to submit a copy of the GST Registration Certificate, while submitting the bids wherever **GST(CGST & SGST/UTGST or IGST)** is applicable
- 13.2 Quoted prices should be inclusive of all taxes and duties, except **GST (CGST & SGST or IGST or UTGST)**. Please note that the responsibility of payment of **GST (CGST & SGST or IGST or UTGST)** lies with the Contractor only. Contractor providing taxable service shall issue an e- Invoice/ Invoice / Bill, as the case may be as per rules/ regulation of GST. Further, returns and details required to be filed under GST laws & rules should be timely filed by Contractor with requisite details.
- Payments to Contractor for claiming **GST (CGST & SGST/UTGST or IGST)** amount will be made provided the above formalities are fulfilled. Further, TFL may seek copies of challan and certificate from Chartered Accountant for deposit of **GST (CGST & SGST/UTGST or IGST)** collected from Owner.
- 13.3 In case CBIC (Central Board of Indirect Taxes and Customs)/ any tax authority / any equivalent Government agency brings to the notice of TFL that the Contractor has not remitted the amount towards **GST (CGST & SGST/UTGST or IGST)** collected from TFL to the government exchequer, then, that Contractor shall be put under Holiday list of TFL for period of six months after following the due procedure. This action will be in addition to the right of recovery of financial implication arising on TFL.
- 13.4 For statutory variation in **GST (CGST & SGST/UTGST or IGST)**, please refer clause no. **13.0 of SCC (Section V of NIT)**
- 13.5 Where TFL is entitled to avail the input tax credit of **GST (CGST & SGST/UTGST or IGST)**:-

13.5.1 Owner/TFL will reimburse the **GST (CGST & SGST/UTGST or IGST)** to the Contractor at actuals against submission of E-Invoices/Invoices as per format specified in rules/regulation of GST, to enable Owner/TFL to claim input tax credit of **GST (CGST & SGST/UTGST or IGST)** paid. In case of any variation in the executed quantities, the amount on which the **GST (CGST & SGST/UTGST or IGST)** is applicable shall be modified in same proportion. Returns and details required to be filled under GST laws & rules should be timely filed by supplier with requisite details.

13.6 Where TFL is not entitled to avail/take the full input tax credit of **GST (CGST & SGST/UTGST or IGST)**:

13.6.1 Owner/TFL will reimburse **GST (CGST & SGST/UTGST or IGST)** to the Contractor at actuals against submission of E-Invoices/Invoices as per format specified in rules/regulation of GST subject to the ceiling amount of **GST (CGST & SGST/UTGST or IGST)** as quoted by the bidder, subject to any statutory variations, except variations arising due to change in turnover. In case of any variation in the executed quantities (If directed and/or certified by the Engineer-In-Charge) the ceiling amount on which **GST (CGST & SGST/UTGST or IGST)** is applicable will be modified on pro-rata basis.

13.7 TFL will prefer to deal with registered supplier of goods/ services under GST. Therefore, bidders are requested to get themselves registered under GST, if not registered yet.

However, in case any unregistered bidder is submitting their bid, Bids will be evaluated as per quoted prices without loading of **GST (CGST & SGST/UTGST or IGST)**, if not quoted. their prices will be loaded with applicable GST (CGST & SGST/UTGST or IGST) while evaluation of bid (if applicable as per Govt. Act/ Law in vogue). Where TFL is entitled for input credit of **GST (CGST & SGST/UTGST or IGST)**, the same will be considered for evaluation of bid as per evaluation methodology of tender document. Further, an unregistered bidder is required to mention its Income Tax PAN in bid document.

13.8 In case TFL is required to pay entire/certain portion of applicable **GST (CGST & SGST/UTGST or IGST)** and remaining portion, if any, is to be deposited by Bidder directly as per **GST (CGST & SGST/UTGST or IGST)** laws, entire applicable rate/amount of **GST (CGST & SGST/UTGST or IGST)** to be indicated by bidder in the SOR.

Where TFL has the obligation to discharge **GST (CGST & SGST/UTGST or IGST)** liability under reverse charge mechanism and TFL has paid or is /liable to pay **GST (CGST & SGST/UTGST or IGST)** to the Government on which interest or penalties becomes payable as per GST laws for any reason which is not attributable to TFL or ITC with respect to such payments is not available to TFL for any reason which is not attributable to TFL, then TFL shall be entitled to deduct/ setoff / recover such amounts against any amounts paid or payable by TFL to Contractor /Supplier.

- 13.9 Contractor shall ensure timely submission of correct invoice(s)/e-invoice(s), as per GST rules/ regulation, with all required supporting document(s) within a period specified in Contract to enable TFL to avail input credit of GST (CGST & SGST/UTGST or IGST). Further, returns and details required to be filled under GST laws & rules should be timely filed by Contractor with requisite details.

If input tax credit is not available to TFL for any reason not attributable to TFL, then TFL shall not be obligated or liable to pay or reimburse GST (CGST & SGST/UTGST or IGST) claimed in the invoice(s) and shall be entitled to deduct/ setoff/ recover such GST amount (CGST & SGST/UTGST or IGST) or Input Tax Credit amount together with penalties and interest, if any, against any amounts paid or becomes payable by TFL in future to the Contractor under this contract or under any other contract

13.10 Anti-profiteering clause

As per Clause 171 of GST Act it is mandatory to pass on the benefit due to reduction in rate of tax or from input tax credit to the consumer by way of commensurate reduction in prices. The Contractor may note the above and quote their prices accordingly.

- 13.11 In case the GST rating of Contractor on the GST portal / Govt. official website is negative / black listed, then the bids may be rejected by TFL. Further, in case rating of bidder is negative / black listed after award of work, then TFL shall not be obligated or liable to pay or reimburse GST to such Contractor and shall also be entitled to deduct / recover such GST along with all penalties / interest, if any, incurred by TFL.

- 13.12 GST (CGST & SGST/UTGST or IGST) is implemented w.e.f. 01.07.2017 which subsumed various indirect taxes and duties applicable before 01.07.2017. Accordingly, the provisions of General Condition of Contract relating to taxes and duties which are subsumed in GST are modified to aforesaid provisions mentioned in clause no. 12 and 13 of ITB.

- 13.13 GST, as quoted by the bidder in Schedule of Rates, shall be deemed as final and binding for the purpose of bid evaluation (applicable for tenders where bidder quotes the GST rates). In case a bidder enters "zero/blank" GST or an erroneous GST, the bid evaluation for finalizing the L1 bidder will be done considering the "Zero" or quoted GST rate GST rate, as the case may be. No request for change in GST will be entertained after submission of bids. In case GST column is left blank in the SOR, the quoted prices shall be considered as "Inclusive of GST" and evaluation shall be done accordingly.

In cases where the successful bidder quotes a wrong GST rate, for releasing the order, the following methodology will be followed:

- In case the actual GST rate applicable is lower than the quoted GST rate, the actual GST rate will be added to the quoted basic prices. The final cash outflow will be based on actual GST rate.
- In case the actual GST rate applicable is more than the quoted GST rate, the basic prices quoted will be reduced proportionately, keeping the final cash outflow the same as the overall quoted amount.

Based on the Total Cash Outflow calculated as above, TFL shall place orders.

13.14 Wherever TDS under GST Laws has been deducted from the invoices raised / payments made to the Contractors, as per the provisions of the GST law / Rules, Contractors should accept the corresponding GST-TDS amount populated in the relevant screen on GST common portal (www.gst.gov.in). Further, Vendors should also download the GST TDS certificate from GST common portal (reference path: Services>User Services> View/Download Certificates option).

13.15 **Provision w.r.t. E- Invoicing requirement as per GST laws:** Supplier who is required to comply with the requirements of E-invoice for B2B transactions as per the requirement of GST Law will ensure the compliance of requirement of E Invoicing under GST law. If the invoice issued without following this process, such invoice can-not be processed for payment by TFL as no ITC is allowed on such invoices.

Therefore, all the payments to such supplier who is liable to comply with e-invoice as per GST Laws shall be made against the proper e-invoice(s) only. Further, returns and details required to be filled under GST laws & rules against such e-invoices should be timely filed by Supplier of Goods with requisite details.

If input tax credit is not available to TFL for any reason attributable to supplier (both for E-invoicing cases and non-E-invoicing cases), then TFL shall not be obligated or liable to pay or reimburse GST (CGST & SGST/UTGST or IGST) claimed in the invoice(s) and shall be entitled to deduct / setoff / recover such GST amount (CGST & SGST/UTGST or IGST) or Input Tax Credit amount together with penalties and interest, if any, by adjusting against any amounts paid or becomes payable in future to the contractor under this contract or under any other supplier .

To ensure compliance, undertaking in requisite format is to be submitted by supplier as per format enclosed at Form F-21 along with documents for release of payment.

13.16 **New Taxes & duties:** Any new taxes & duties, if imposed by the State/ Central Govt. of India after the due date of bid submission but before the Contractual Completion Date, shall be reimbursed to the Service Provider on submission of copy of notification(s) issued from State/ Central Govt. Authorities along with documentary evidence for proof of payment of such taxes & duties, but only after ascertaining it's applicability with respect to the Contract.

13.17 Full payment including GST will be released at the time of processing of invoice for payment, where the GST amount reflects in Form GSTR-2A of TFL. However, in case where the GST amount doesn't reflect in Form GSTR-2A of TFL, the amount of GST will be released after reflection of GST amount of corresponding invoice in Form GSTR-2A of TFL.

14 BID CURRENCIES:

Bidders must submit bid in Indian Rupees only.

15 BID VALIDITY

15.1 Bids shall be kept valid for period specified in BDS from the final Due date of submission of bid'. A Bid valid for a shorter period may be rejected by TFL as 'non-responsive'.

- 15.2 In exceptional circumstances, prior to expiry of the original 'Bid Validity Period', the Employer may request the Bidders to extend the 'Period of Bid Validity' for a specified additional period. The request and the responses thereto shall be made in writing or by email. A Bidder may refuse the request without forfeiture of his EMD / Bid Security.

A Bidder agreeing to the request will not be required or permitted to modify his Bid, but will be required to extend the validity of its EMD for the period of the extension and in accordance with "ITB: Clause-16" in all respects.

16 EARNEST MONEY DEPOSIT

- 16.1 Bid must be accompanied with earnest money (i.e. Earnest Money Deposit (EMD) also known as Bid Security) in the form of '**Demand Draft**' / '**Banker's Cheque**' / '**Insurance Surety Bond**' / '**Fixed Deposit Receipt**' [in favour of **Talcher Fertilizers Limited** payable at place mentioned in BDS] or 'Bank Guarantee' strictly as per the format given in form F-2A (as the case may be) of the Tender Document. Bidder shall ensure that EMD submitted in the form of 'Bank Guarantee' should have a validity of at least "two [02] months" beyond the validity of the Bid. EMD submitted in the form of 'Demand Draft' or 'Banker's Cheque' should be valid for three months.

Bid not accompanied with EMD, or EMD not in requisite format shall be liable for rejection. The EMD shall be submitted in Indian Rupees only.

- 16.2 The bidder can also submit the EMD through online banking transaction i.e. IMPS/NEFT/RTGS etc. For this purpose, the details of TFL's Bank Account are mentioned under BDS. While remitting, the bidder must indicate EMD and tender/E-tender no. under remarks. Bidders shall be required to submit/ upload the successful transaction details along-with their bid/e-bid in addition to forwarding the details to dealing officer through email/letter with tender reference number immediately after remittance of EMD. In absence of submitting/ uploading the remittance details, the bid is likely to be considered as bid not accompanied with EMD. Further, in case of the online transaction, submission of EMD in original is not applicable.
- 16.3 OWNER shall not be liable to pay any documentation charges, Bank charges, commission, interest etc. on the amount of EMD. In case EMD is in the form of a "Bank Guarantee", the same shall be from any Indian scheduled Bank (excluding Co-operative banks and Regional Rural bank) or a branch of an International Bank situated in India and registered with "Reserve Bank of India" as Scheduled Foreign Bank. However, in case of „Bank Guarantee" from Banks other than the Nationalized Indian Banks, the Bank must be commercial Bank having networth in excess of Rs. 100 Crores [Rupees One Hundred Crores] and a declaration to this effect should be made by such commercial Bank either in the "Bank Guarantee" itself or separately on its letterhead. Purchaser will verify the BG from issuing bank.
- 16.4 Any Bid not secured in accordance with "ITB: Clause-16.1 & Clause-16.3" may be rejected by TFL as non-responsive.
- 16.5 Unsuccessful Bidder's EMD will be discharged/ returned as promptly as possible, but not later than "thirty [30] days" after finalization of tendering process.
- 16.6 The successful Bidder's EMD will be discharged upon the Bidder's acknowledging the "Award" and signing the "Agreement" (if applicable) and furnishing the Contract Performance Security (CPS)/ Security Deposit" pursuant to clause no. 38 of ITB.

- 16.7 Notwithstanding anything contained herein, the EMD may also be forfeited in any of the following cases:
- (a) If a Bidder withdraws his Bid during the "Period of Bid Validity"
 - (b) If a Bidder has indulged in corrupt/fraudulent /collusive/coercive practice
 - (c) If the Bidder modifies Bid during the period of bid validity (after Due Date and Time for Bid Submission).
 - (d) Violates any other condition, mentioned elsewhere in the Tender Document, which may lead to forfeiture of EMD.
 - (e) In case of Cartelization of bid.
 - (f) In the case of a successful Bidder, if the Bidder fails to:
 - (i) to acknowledge receipt of the "Notification of Award" / Fax of Acceptance[FOA] / Detailed Letter of Acceptance [DLOA]",
 - (ii) to furnish "Contract Performance Security / Security Deposit", in accordance with "ITB: Clause-38".
- 16.8 In case EMD is in the form of „Bank Guarantee“, the same must indicate the Tender Document No. and the name of Tender Document for which the Bidder is quoting. This is essential to have proper correlation at a later date.
- 16.9 The Government Departments/PSUs are also exempted from the payment of EMD. Further, Startups are also exempted from the payment of EMD. MSEs (Micro & Small Enterprises) are not exempted from submission of EMD as this is works contract.
- 16.10 In case of forfeiture of EMD/ Bid Security, the forfeited amount will be considered inclusive of tax and tax invoice will be issued by TFL. The forfeiture amount will be subject to final decision of TFL based on other terms and conditions of order/contract.
- 16.11 EMD/Bid Bond will not be accepted in case the same has reference of 'remitter'/'financer' other than bidder on the aforementioned financial instrument of EMD/ Bid Bond submitted by the bidder and bid of such bidder will be summarily rejected.**
16. A **DECLARATION FOR BID SECURITY**
- MSEs (Micro & Small Enterprises), Start-ups and CPSEs (to whom exemption is allowed as per extant guidelines in vogue) are required to submit, "DECLARATION FOR BID SECURITY" as per prescribed format (F-2B).
- 17 PRE-BID MEETING (IF APPLICABLE)**
- 17.1 The Bidder(s) or his designated representative are invited to attend a "Pre-Bid Meeting" which will be held at address specified in IFB. It is expected that a bidder shall not depute more than 02 representatives for the meeting.
- 17.2 Purpose of the meeting will be to clarify issues and to answer questions on any matter that may be raised at that stage and give hands-on e-tendering.

17.3 Text of the questions raised and the responses given, together with any responses prepared after the meeting, will be uploaded on Central Public Procurement (CPP) Portal (<https://eprocure.gov.in/eprocure/app>) websites. Any modification of the Contents of Bidding Documents listed in "ITB: Clause-7.1", that may become necessary as a result of the Pre-Bid Meeting shall be made by the Employer exclusively through the issue of an Corrigendum pursuant to "ITB: Clause-9", and not through the minutes of the Pre-Bid Meeting.

17.4 Non-attendance of the Pre-Bid Meeting will not be a cause for disqualification of Bidder.

18 FORMAT AND SIGNING OF BID

18.1 The original and all copies of the Bid shall be typed or written in indelible ink [in the case of copies, photocopies are also acceptable] and shall be signed by a person or persons duly authorized to sign on behalf of the Bidder (as per POA). The name and position held by each person signing, must be typed or printed below the signature. All pages of the Bid except for unamendable printed literature where entry(s) or amendment(s) have been made shall be initialed by the person or persons signing the Bid.

18.2 The Bid shall contain no alterations, omissions, or additions, unless such corrections are initialed by the person or persons signing the Bid.

18.3 In case of e-tendering, digitally Digitally signed documents to be uploaded as detailed in addendum to ITB (Annexure-III of Section –III).

19 ZERO DEVIATION AND REJECTION CRITERIA

19.1 ZERO DEVIATION: Deviation to terms and conditions of "Bidding Documents" may lead to rejection of bid. TFL will accept bids based on terms & conditions of "Bidding Documents" only. Bidder may note TFL will determine the substantial responsiveness of each bid to the Tender documents pursuant to provision contained in clause 29 of ITB. For purpose of this, a substantially responsive bid is one which conforms to all terms and conditions of the Bidding documents without deviations or reservations. TFL's determination of a bid's responsiveness is based on the content of the bid itself without recourse to extrinsic evidence.

Bidder is requested not to take any deviation(s)/exception(s) to the terms & conditions of Tender Document, and submit all requisite documents as mentioned in this Tender Document, failing which their Bid will be liable for rejection. If a Bidder does not reply to the queries in the permitted time frame then its Bid shall be evaluated based on the documents available in the Bid.

As a principle, clarifications from bidders after opening of tenders will not be sought. However, where clarifications / documents from the bidders on important aspects are absolutely necessary for finalization of tender, clarifications from bidder can be asked. The request for clarification shall be given in email/portal, asking the bidder to respond by a specified date, and also mentioning therein that, if the bidder does not comply or respond by the date, his tender will be liable to be rejected. Depending on the outcome, such tenders are to be ignored or considered further. No change in prices or substance of the bid including specifications, shall be offered or permitted. No post-bid clarification at the initiative of the bidder shall be entertained. The shortfall information/ documents should be sought only in case of historical documents which pre-existed bids and which have not undergone change since then.

19.2 **REJECTION CRITERIA:** Notwithstanding the above, deviation to the following clauses of Tender document shall lead to summarily rejection of Bid:

- a) Bidder not meeting Bid Evaluation Criteria as per Tender Document
- b) Firm Price
- c) EMD / Declaration for Bid Security (as applicable)
- d) Specifications & Scope of Work
- e) Schedule of Rates / Price Schedule / Price Basis
- f) Duration / Period of Contract/ Completion Period
- g) Payment Terms
- h) Period of Validity of Bid
- i) Integrity Pact
- j) Mutually Agreed Damages
- k) Overall ceiling on total liability
- l) Contract Performance Security
- m) Guarantee / Defect Liability Period
- n) Arbitration / Settlement of Dispute
- o) Governing laws, language & measures
- p) Force Majeure
- q) Undertaking forms, Form I of Annexure VII for provision for procurement from a bidder which shares a land border with India
- r) Bidder quoting less than 20% as minimum Local content (as per make in India PPLC policy)
- s) Any other condition specifically mentioned in the tender document elsewhere that non-compliance of the clause lead to rejection of bid

Note: Further, it is once again reminded not to mention any condition in the Bid which is contradictory to the terms and conditions of Tender document.

20 **E-PAYMENT**

OWNER has initiated payments to Contractors electronically, and to facilitate the payments electronically through 'e-banking'.

[D] – SUBMISSION OF BIDS

21 **SUBMISSION, SEALING AND MARKING OF BIDS**

21.1 In case of e-tendering, bids shall be submitted through e-tender in the manner specified elsewhere in tender document. No Manual/ Hard Copy (Original) offer shall be acceptable. Physical documents shall be addressed to the owner at address specified in IFB.

21.2 Deleted

21.3 Bids submitted under the name of AGENT/ REPRESENTATIVE /RETAINER/ ASSOCIATE etc. on behalf of a bidder/affiliate shall not be accepted.

22 DEADLINE FOR SUBMISSION OF BIDS

22.1 In case of e-bidding, the bids must be submitted through e-tender mode not later than the date and time specified in the tender document/BDS (Bidding Data Sheet).

22.2 Deleted.

22.3 TFL may, in exceptional circumstances and at its discretion, extend the deadline for submission of Bids (clause 8 and/or 9 of ITB refers). In which case all rights and obligations of TFL and the Bidders, previously subject to the original deadline will thereafter be subject to the deadline as extended Notice for extension of due date of submission of bid will be uploaded on website only as mentioned in Clause No. 2.0(G) of IFB.

23 LATE BIDS

23.1 Any bids received after the notified date and time of closing of tenders will be treated as late bids.

23.2 In case of e-tendering, e-tendering system of CPP Portal (eprocure.gov.in) shall close immediately after the due date for submission of bid and no bids can be submitted thereafter.

23.3 Physical documents received to address other than one specifically stipulated in the Tender Document will not be considered for evaluation/opening/award if not received to the specified destination within stipulated date & time.

23.4 Unsolicited Bids or Bids received to address other than one specifically stipulated in the tender document will not be considered for evaluation/opening/award if not received to the specified destination within stipulated date & time.

24 MODIFICATION AND WITHDRAWAL OF BIDS

24.1 Modification and withdrawal of bids shall be as follows:-

24.1.1 IN CASE OF E- TENDERING

The bidder may withdraw or modify its bid after bid submission but before the due date and time for submission as per tender document.

24.1.2 IN CASE OF MANUAL BIDDING

Deleted.

[E] – BID OPENING AND EVALUATION

25 EMPLOYER'S RIGHT TO ACCEPT ANY BID AND TO REJECT ANY OR ALL BIDS

- 25.1 TFL reserves the right to accept or reject any Bid, and to annul the Bidding process and reject all Bids, at any time prior to award of Contract, without thereby incurring any liability to the affected Bidder(s) or any obligations to inform the affected Bidder(s) of the ground for TFL's action. However, Bidder if so desire may seek the reason (in writing) for rejection of their Bid to which TFL shall respond quickly.
- 25.2 A bidder is to be permitted to send his representation in writing to dealing officer specified in tender for rejection of bid. But, such representation has to be sent upto 10(ten) days from the date of Notification of Award/FOA. A decision on representation will be taken by TFL within 15 (fifteen) days of the receipt of the representation. Only a directly affected bidder can represent in this regard:
- i) Only a bidder who has participated in tender can make such representation
 - ii) In case technical bid has been evaluated before the opening of the financial bid, an application for review in relation to the financial bid may be filed only by a bidder whose technical bid is found to be acceptable
- 25.3 However, following decisions of TFL shall not be subject to review:
- a) Determination of the need for procurement;
 - b) Selection of the mode of procurement or bidding system;
 - c) Choice of selection procedure;
 - d) Provisions limiting participation of bidders in the procurement process;
 - e) The decision to enter into negotiations with the L1 bidder;
 - f) Cancellation of the procurement process except where it is intended to subsequently re-tender the same requirements;
 - g) Issues related to ambiguity in contract terms may not be taken up after a contract has been signed, all such issues should be highlighted before consummation of the contract by the vendor/ contractor; and
 - h) Complaints against specifications except under the premise that they are either vague or too specific so as to limit competition may be permissible.

26 BID OPENING

26.1 Unpriced Bid Opening:

TFL/PDIL will open the price bids of those Bidders who meet the qualification requirement and whose bid is determined to be technically and commercially responsive. Techno-commercial bid evaluation status will be are to be informed to all bidders (including informing the techno-commercially not qualified Bidders). Price bids are to be opened in the presence of only techno-commercially acceptable bidders, who are willing to attend the bid opening, at a pre-publicised date, time and place or on the portal in case of e-procurement. The bidder's name, bid price, discount (if any) and any such details considered appropriate shall be read out during the price bid opening. Offers should not, repeat not, be circulated amongst the bidder's representative. Bidders selected for opening of their price bid shall be informed about the date & time of price bid opening. Bidders may depute their authorized representative to witness the price bid opening. The Bidders' representatives, who are present shall sign a Price Bid Opening Register evidencing their attendance and may be required to be present even on a short notice.

26.2 **Priced Bid Opening:**

26.2.1 TFL will open the price bids of those bidders who meet the qualification requirement and whose bids is determined to be technically and commercially responsive. Bidders selected for opening of their price bids shall be informed about the date of price bid opening.

Bidders may depute their authorized representative to attend the bid opening. The bidders' representatives, who are present shall sign a register evidencing their attendance and may be required to be present even on a short notice.

26.2.2 The price bids of those Bidders who were not found to be techno-commercially responsive shall not be opened.

In case of bids invited under the single bid system, bid shall be opened on the specified date & time.

26.3 **Reverse Auction**

26.3.1 OWNER shall finalize tender after conducting reverse auction except in those cases where less than four techno-commercially acceptable offers are available.

In case, after techno commercial evaluation, number of technically & commercially acceptable offers are less than 04 (four), then no reverse auction will be conducted (but the OWNER/CONSULTANT shall take appropriate decision regarding conducting offline price negotiation, if required).

Accordingly, the decision to conduct reverse auction shall be communicated to shortlisted bidders prior to opening of price bid. The due date and time of conducting the event of Reverse Auction (if conducted) shall be intimated well in advance to the techno commercially acceptable bidders, through email.

26.3.2 **Detailed methodology of Reverse Auction**

With the assistance of RA system provider, training to all eligible bidders on the Online Reverse Auction process shall be facilitated prior to conduct of Online Reverse Auction.

- a) Computerized Reverse Auction shall be conducted by PDIL through M/s e-Procurement Technologies Limited, on pre-specified date, while the bidders shall be quoting from their own offices/ place of their choice.
- b) The due date and time of conducting the event of Reverse Auction shall be intimated at least 2 (two) days in advance to the techno-commercially acceptable bidders, through email / letter. For better understanding of Reverse Auction by the bidders, one day online training shall be conducted by M/s e-Procurement Technologies Limited i.e. the agency conducting the Reverse Auction, for all the techno-commercially qualified bidders. Reverse Auction Training and Demo auction shall be conducted through Video conferencing only.

- c) A user-ID and a password shall be created for each techno-commercially qualified bidder by the M/s e-Procurement Technologies Limited and the same shall be communicated to the bidders during the training process. A Valid Digital Signature Certificate is required to take part in Reverse Bidding process.
- d) Display of Details during Reverse Auction(RA)

The bidder will be able to view the following details on their screen during RA:

- 1) "Total basic Price" (i.e. Total Price excluding GST)
- 2) "Loading factor", if any
- 3) "Total Evaluated Price" (i.e. Total Basic Price x Loading factor, calculated by system)
- 4) "Rank of the bidder" (i.e. present rank, auto updated by system)
- 5) "L1 price" (i.e. Present Lowest Total Evaluated Price, auto updated by system)

The "Total basic Price", Loading factor and the "Total Evaluated Price" before RA shall be informed to individual bidders shortly after completion of the RA training. The "Total basic Price" before RA shall be the "Start price" of each bidder. During RA, the bidder will be able to reduce only the "Total Basic Price". The "Total Evaluated Price" will be automatically calculated by the system and system will then compare it with "Total Evaluated Price" of other bidders to arrive at Rank and L1 price after every price change during the RA. After completion of RA, the "Total Evaluated Price" of the lowest bidder shall be considered as the L-1 price after RA.

However, at no point of time will any bidder see names of other bidders, or prices of bidders other than the lowest bid. The Bidder has to out-bid his own previous price & try to reach Number-1 rank.

The tender shall be processed further for award or otherwise based on L-1 prices received at the end of Online Reverse Auction. Price reasonableness will still need to be established by PDIL/TFL even though the bidding is through Online Reverse Auction and TFL will reserve the right to negotiate with the L1 bidder as per CVC guidelines.

- e) All timings of the online bid shall be based on the time indicated by the Server hosting the Auction Engine which would reflect as closely as possible the Indian Standard Time (IST) i.e. GMT+05:30 hrs. However, in the event of any deviations between the Server Time and the Indian Standard Time, the functioning of the Auction Engine (launch, operation and closure) would be guided by the Server time. Bidders should be advised to refresh the window of the Auction module and check the exact server Time.
- f) The start price of bidders will be automatically populated by system at the time of start of Reverse Auction. The same will be considered as participation by bidder in Online Reverse Auction process. In case any bidder emerges lowest bidder after RA based on their start price(s), the same will be considered as their final price(s) taking into consideration respective loading factor (to arrive at "Total Evaluated Price") for award of contract/ order irrespective of whether bidder had actually logged in RA portal or not. In case bidder does not accept the same, such bidder will be considered as errant bidder and action will be taken against bidder as per provision in this regard.

- g) During Reverse Auction, a bidder can reduce his prices repeatedly. The minimum percentage reduction in each step namely, the bid decrement' shall not be less than 0.5% of the last bid of the respective bidder. Bidders are allowed to submit/accept first price without decrement amount but afterwards participation in reverse auction is allowed only with minimum decrement amount /percentage.
- h) The process of Online Reverse Auction shall initially be held for a period of 30 minutes. In the event of a bid received in the last 5 minutes resulting in a change of prevailing L1 price, the period of the auction shall get extended automatically by 8 minutes from the time of submission of such bid. This process will continue till no change in L-1 price takes place in last 5 minutes after which the auction will close. All bidders regardless of their previous position can submit their bid during the extended period also.
- i) In case of a tie during auction i.e. two bidders entering same lowest price, the bidder who enters the prices first in the system would be taken as L-1 and the other bidder would see their ranking as L-2.
- j) Internet connectivity shall have to be ensured by bidders themselves. Bidders are requested to make all the necessary arrangements/ alternatives whatever required so that they are able to circumvent such situation and still be able to participate in the Reverse Auction successfully.
- k) Bidders in their own interest should ensure uninterrupted internet connectivity at their end during the reverse auction with necessary backups to take care of any connectivity problem. No request for any extension of RAP due to internet connectivity issues or for any other reason at bidders end shall be entertained by PDIL/TFL.
- l) In case of disruption of service at the service provider's end i.e. M/s e-Procurement Technologies Limited while the RAP (Reverse Auction Process) is online, due to any technical snag or otherwise attributable to the system failure at the server end, the RAP process will start all over again, through a fresh RAP (hereinafter referred to as "Restarted RAP"), the time and date of which will be intimated in writing to all bidders. In such a situation, the last recorded lowest price of prematurely ended RAP, will be the 'Start Bid Price' for the "Re-started RAP". The prices quoted in the prematurely ended RAP will be binding on all the bidders for consideration. All the time stipulations of normal RAP will be applicable to the "Restarted RAP".
- m) Communication with any official with service provider/PDIL/TFL when the RAP is online is strictly prohibited. Bidders in their own interest will have to get themselves satisfied on any queries that they may have during the RAP training session. No query when the RAP is online will be entertained.
- n) Upon completion of reverse auction, rate of individual items of SOR shall be worked out applying uniform reduction (reduction being derived from the original Total Evaluated Price & final Total Evaluated Price after RA).
- o) While working out rate of individual items, unit rate upto two decimals only will be considered and the figures beyond two decimals shall be ignored without rounding off (e.g. if item rates after applying uniform reduction works out to 10.910 or 10.912 or 10.915 or 10.919, the rate will be considered as 10.91). Above prices shall be the final prices of lowest bidder against the tender for all the purposes and the original quoted prices against tender shall no more be valid for tender for which Reverse Auction was held.

26.3.3 Preferences: Purchase Preference shall be applicable as defined in tender document.

27 CONFIDENTIALITY

Information relating to the examination, clarification, evaluation and comparison of bids, and recommendations for the award of a contract, shall not be disclosed to bidders or any other person not officially concerned with such a process until the award to the successful bidder.

28 CONTACTING THE EMPLOYER

28.1 From the time of bid opening to the time of contract award, no bidder shall contact TFL on any matter related to the bid, except on request and prior written permission.

28.2 Any effort by the bidder to influence TFL in bid evaluation, bid comparison or contract award decisions will vitiate the process and will result in the rejection of the bidder's bid and action shall be initiated as per the TFL's procedure for action in case Corrupt / Fraudulent / Collusive / Coercive practices in this regard apart from forfeiture of EMD/ Bid Security, if any.

29 EXAMINATION OF BIDS AND DETERMINATION OF RESPONSIVENESS

29.1 The employer's determination of a bid's responsiveness is based on the content of the bid only. Prior to the detailed evaluation of Bids, the Employer will determine whether each Bid:

- (a) Meets the "Bid Evaluation Criteria" of the Bidding Documents ;
- (b) Has been properly signed;
- (c) Is accompanied by the required 'Earnest Money / Bid Security / Bid Security Declaration'
- (d) Is substantially responsive to the requirements of the Bidding Documents ; and
- (d) Provides any clarification and/or substantiation that the Employer may require to determine responsiveness pursuant to "ITB: Clause-29.2"

29.2 A substantially responsive Bid is one which conforms to all the terms, conditions and specifications of the Bidding Documents without material deviations or reservations or omissions for this purpose employer defines the foregoing terms below:

- a) "Deviation" is departure from the requirement specified in the tender documents.
- b) "Reservation" is the setting of limiting conditions or withholding from complete acceptance of the requirement in the tender documents.
- c) "Omission" is the failure to submit part or all of the information or documentation required in the tender document for evaluation of bid.

29.3 A material deviation, reservation or omission is one that,

- a) If accepted would,
 - i) Affect in any substantial way the scope, quality, or performance of the job as specified in tender documents.
 - ii) Limit, in any substantial way, inconsistent with the Tender Document, the Employer's rights or the tenderer's obligations under the proposed Contract.
- b) If rectified, would unfairly affect the competitive position of other bidders presenting substantially responsive bids.

29.4 The employer shall examine all aspects of the bid to confirm that all requirements have been met without any material deviation, reservation or omission.

29.5 Tenders that do not meet the basic requirements specified in the bid documents are to be treated as unresponsive (both during Techno-commercial evaluation and Financial Evaluation in case of Two Bid System) and will be ignored. All tenders received will first be scrutinized to see whether the tenders meet the basic requirements as incorporated in the Bid document and to identify unresponsive tenders, if any. Unresponsive offers may not subsequently be made responsive by correction or withdrawal of the non-conforming stipulation. Some important points on the basis of which a tender may be declared as unresponsive and be ignored during the initial scrutiny are :

- i) The tender is not in the prescribed format or is unsigned or not signed as per the stipulations in the bid document;
- ii) The required EMD has not been provided or exemption from EMD is claimed without acceptable proof of exemption;
- iii) The bidder is not eligible to participate in the bid as per laid down eligibility criteria
- iv) The bid departs from the essential requirements specified in the bidding document (for example, the tenderer has not agreed to give the required contract performance security); or
- v) Against a schedule in the list of requirements in the tender enquiry, the tenderer has not quoted for the entire requirement as specified in that schedule (example: in a schedule, it has been stipulated that the tenderer will supply the equipment, install and commission it and also train the TFL's personnel for operating the equipment. The tenderer has, however, quoted only for supply of the equipment).

30 CORRECTION OF ERRORS-

Not Applicable.

31 CONVERSION TO SINGLE CURRENCY FOR COMPARISON OF BIDS

Not Applicable. All bids submitted must be in the currency specified at clause 14 of ITB.

32 EVALUATION AND COMPARISON OF BIDS

Bid shall be evaluated as per evaluation criteria mentioned in Section-II of bidding documents on lowest bid basis.

In case of a tie at the lowest bid (L1) position between two or more bidders, the order/LoA will be placed on the bidder who has higher/ highest turnover in last audited financial year.

In case there is a tie at the lowest bid (L1) position between only startup bidders and none of them has past turnover, the order/FOA will be placed on the startup who is registered earlier with Department for Promotion of Industry and Internal Trade (wherever applicable).

33 COMPENSATION FOR EXTENDED STAY [FOR APPLICABILITY OF THIS CLAUSE REFER BDS]:

Not Applicable

34 **PURCHASE PREFERENCE**

Purchase Preference as per Policy to Provide Purchase Preference as per Public Procurement (Preference to Make in India), Order 2017 Domestically Manufactured Telecom Products (DMTP) shall be allowed as per Government instructions in vogue, as applicable from time to time.

The Policy to Provide Purchase Preference as per Public Procurement (Preference to Make in India), Order is enclosed as Annexure V to ITB herewith.

Bidders are required to select the applicable purchase preference (i.e. preference category) option while submitting the bid on GePNIC portal. However, evaluation and applicability of purchase preference policy will be based on the confirmations & documents submitted by the bidder in their bid irrespective of selection made on GePNIC portal.

[F] – AWARD OF CONTRACT

35 **AWARD**

Subject to "ITB: Clause-29", Owner will award the Contract to the successful Bidder whose Bid has been determined to be substantially responsive and has been determined as the lowest provided that bidder, is determined to be qualified to satisfactorily perform the Contract.

“TFL intends to place the contract directly on the address from where Goods are produced / dispatched or Services are rendered. In case, bidder wants contract at some other address or supply of Goods/ Services from multiple locations, bidder is required to provide in their bid address on which order is to be placed.”

TFL will place the Contract directly on the successful bidder from whom the bid has been received & evaluated and will not place order on other entities such as subsidiary, business associate or partner, dealer/distributor etc. of the Bidder.

36 **NOTIFICATION OF AWARD / FAX OF ACCEPTANCE**

- 36.1 Prior to the expiry of 'Period of Bid Validity', Notification of Award for acceptance of the Bid will be intimated to the successful Bidder by TFL either by E-mail /Letter or like means defined as the "Fax of Acceptance (FOA)". The Contract shall enter into force on the date of FOA and the same shall be binding on TFL and successful Bidder (i.e. Contractor). The Notification of Award/FOA will constitute the formation of a Contract. The detailed Letter of Acceptance shall be issued thereafter incorporating terms & conditions of Tender Document, Corrigendum, Clarification(s), Bid and agreed variation(s)/acceptable deviation(s), if any. TFL may choose to issue Notification of Award in form of detailed Letter of Acceptance without issuing FOA and in such case the Contract shall enter into force on the date of Detailed Letter of Acceptance only.

- 36.2 Contract period shall commence from the date of "Notification of Award" or as mentioned in the Notification of Award. The "Notification of Award" will constitute the formation of a Contract, until the Contract has been effected pursuant to signing of Contract as per "ITB: Clause-37".
- 36.3 Upon the successful Bidder's / Contractor's furnishing of 'Contract Performance Security / Security Deposit', pursuant to "ITB: Clause-38", TFL will promptly discharge his 'Earnest Money Deposit / Bid Security (if applicable)', pursuant to "ITB: Clause-16".
- 36.4 The Order/ contract value mentioned above is subject to Mutually Agreed Damages clause.
- 36.5 TFL will award the Contract to the successful Bidder, who, within 'fifteen [15] days' of receipt of the same, shall sign and return the acknowledged copy to TFL.

37 SIGNING OF AGREEMENT

The successful Bidder/Contractor shall be required to execute an 'Agreement' in the proforma given in this Bidding Document) on a 'non-judicial stamp paper' of appropriate value [cost of the 'stamp-paper' shall be borne by the successful Bidder/Contractor] and of 'state of India' specified in Bidding Data Sheet (BDS) only, within 'fifteen [15] days' of receipt of the "Fax of Acceptance (FOA)" by the successful Bidder/Contractor failure on the part of the successful Bidder/Contractor to sign the 'Agreement' within the above stipulated period, shall constitute sufficient grounds for forfeiture of EMD / Security Deposit / Action as per Bid Security declaration.

38 CONTRACT PERFORMANCE SECURITY / SECURITY DEPOSIT(CPS/SD)

- 38.1 Within 30 days of the receipt of the notification of Award/ Fax of Acceptance (FOA) by from TFL, the successful bidder shall furnish the Contract Performance Security (CPS) in accordance with of General Conditions of the Contract. The CPS shall be in the form of either Banker's Cheque or Demand Draft or Bank Guarantee or Letter of Credit and shall be in the currency of the Contract. However, CPS shall not be applicable in cases wherein the individual contract value as specified in Notification of Award is less than INR 5 Lakh (exclusive of GST).
- 38.2 The CONTRACT PERFORMANCE SECURITY shall be for an amount equal specified in Bidding Data Sheet (BDS) towards faithful performance of the contractual obligations and performance of equipment. For the purpose of CPS, Contract/order value shall be exclusive of **GST (CGST & SGST/UTGST or IGST)** .

Bank Guarantee towards CPS shall be from any Indian scheduled bank or a branch of an International bank situated in India and registered with Reserve Bank of India as scheduled foreign bank . However, in case of bank guarantees from banks other than the Nationalized Indian banks, the bank must be a commercial bank having net worth in excess of Rs 100 crores and a declaration to this effect should be made by such commercial bank either in the Bank Guarantee itself or separately on its letterhead.

- 38.3 Failure of the successful bidder to comply with the requirements of this article shall constitute sufficient grounds for consideration of the annulment of the award and Forfeiture of EMD/action as per declaration of Bid Security.

38.4 The CPS has to cover the entire contract value including extra works/services also. As long as the CPS submitted at the time of award take cares the extra works/services executed and total executed value are within the awarded contract price, there is no need for additional CPS. As soon as the total executed value is likely to burst the ceiling of awarded contract price, the contractor should furnish additional CPS.

38.5 DELETED

38.6 In addition to existing specified form (i.e. Demand Draft (DD)/ Banker's Cheque/ Bank Guarantee) mentioned in tender documents for submission of Security Deposit/ Contract Performance Security, the successful bidder can also submit the Security Deposit/ Contract Performance Security through online banking transaction i.e. IMPS/NEFT/RTGS/SWIFT etc. For this purpose, the details of TFL's Bank Account is mentioned in BDS. Further, in case a successful Bidder is willing to furnish CPS through SWIFT, the details may be obtained from Purchase Officer immediately after receipt of FOA.

While remitting such online transaction, the bidder must indicate "**Security Deposit/ Contract Performance Security against FOA/DLOA no. _____ (contractor to specify the FOA/DLOA No.)**" under remarks column of such transaction of respective bank portal. The contractor/vendor shall be required to submit the successful transaction details to the dealing officer immediately through email/letter and necessarily within 30 days from the date of Fax of Acceptance.

38.7 In case of forfeiture of Contract Performance Security/ Security Deposit in terms of GCC, the forfeited amount will be considered inclusive of tax and tax invoice will be issued by TFL. The forfeiture amount will be subject to final decision of TFL based on other terms and conditions of order/ contract.

38.8 The Contractor will also submit covering letter along with CPS as per format at F-4.

38.9 CPBG/Security Deposit will not be accepted in case the same has reference of 'remitter'/financer' other than bidder on the aforementioned financial instrument of CPBG/ Security Deposit submitted by the Contractor.

38.10 The first payment to vendor is to be released only after submission of CPS / Security Deposit (SD).

38.11 Before the CPS / Security Deposit (SD) is released a "No Claim Certificate" is to be submitted by the supplier/vendor.

38.12 In case, TFL allows additional time for submission of CPBG/SD beyond 30 days, a penal interest of Marginal Cost of Fund based Lending Rate (MCLR) for one year charged by SBI (applicable on due date of submission of CPBG/SD i.e. 30th day after issuance of FOA/Notification of award) plus 4.0% p.a (on CPBG/SD amount) shall be charged for delay beyond 30 days i.e. from 31st days after issuance of FOA.

38.13 **In addition to submission of the Security cum Performance Bank Guarantee (CS cum PBG) for 10% of the TOTAL CONTRACT PRICE as stipulated above, the successful bidder is required to submit a Additional Bank Guarantee as specified in Clause 52.0 of SCC.**

39 PROCEDURE FOR ACTION IN CASE CORRUPT/FRAUDULENT/COLLUSIVE/COERCIVE PRACTICES

39.1 Procedure for action in case Corrupt/ Fraudulent/Collusive/Coercive Practices is enclosed at Annexure-I.

39.4 NON-APPLICABILITY OF ARBITRATION CLAUSE IN CASE OF BANNING OF VENDORS/ SUPPLIERS / CONTRACTORS/ BIDDERS/ CONSULTANTS INDULGED IN FRAUDULENT/ COERCIVE PRACTICES

Notwithstanding anything contained contrary in GCC and other "CONTRACT DOCUMENTS", in case it is found that the Contractors/Bidders indulged in fraudulent/coercive practices at the time of bidding, during execution of the contract etc. and/or on other grounds as mentioned in OWNER's "Procedure for action in case Corrupt/Fraudulent/Collusive/Coercive Practices" (Annexure-I to Section-III of tender), the contractor/bidder shall be banned (in terms of aforesaid procedure) from the date of issuance of such order by TFL, to such Contractors/Bidders.

The Contractor/ Bidder understands and agrees that in such cases where Contractor/ Bidder has been banned (in terms of aforesaid procedure) from the date of issuance of such order by TFL, such decision of TFL shall be final and binding on such Contractor/ Bidder and the 'Arbitration clause' in the GCC and other "CONTRACT DOCUMENTS" shall not be applicable for any consequential issue /dispute arising in the matter.

40 PUBLIC PROCUREMENT POLICY FOR MICRO AND SMALL ENTERPRISES

40.1 Government of India, vide Gazette of India No. 503 dated 26.03.2012 proclaimed the Public Procurement Policy for Micro and Small Enterprises (MSEs). The following benefit is available in case of work contract also:

- i) Issue of tender document to MSEs free of cost.
- ii) ~~Exemption to MSEs from payment of EMD/Bid Security.~~

40.2 Deleted

40.3 If against an order placed by TFL, successful bidder(s) (other than Micro/Small Enterprise) is procuring material/services from their sub-vendor who is a Micro or Small Enterprise as per provision mentioned at clause no.40.2 with prior consent in writing of the purchasing authority/Engineer-in-charge, the details like Name, Registration No., Address, Contact No. details of material & value of procurement made, etc. of such Enterprises shall be furnished by the successful bidder at the time of submission of invoice/Bill.

40.4 The benefit of policy are not extended to the traders/dealers/ Distributors /Stockiest/Wholesalers and in Works Contract.

40.5 NSIC has initiated a scheme of "Consortia and Tender Marketing Scheme" under which they are assisting the Micro & Small enterprises to market their products and services through tender participation on behalf of the individual unit or through consortia.

Accordingly, if the MSEs or the consortia, on whose behalf the bid is submitted by NSIC, is meeting the BEC and other terms and conditions of tender their bid will be considered for further evaluation.

Further, in such cases a declaration is to be submitted by MSE/ consortia on their letter head (s) that all the terms and conditions of tender document shall be acceptable to them.

40.6 It may be noted that Government of India has implemented Trade Receivable Discounting System (TReDS) to address challenges faced by MSMEs in delayed payments (after receipt/acceptance of Material/Services) from Government buyers leading to shortfall of Working Capital. TReDS is an online electronic institutional mechanism for facilitating the financing of trade receivables of MSMEs through multiple financiers. TFL is already registered on the following TReDS platform:

- M/s Receivable Exchange of India (RXIL), Mumbai
- M/s Mynd Solutions Private Limited (Mynd), New Delhi
- M/s A. TREDS (Invoicemart), Mumbai

MSME Bidders are required to register on the TReDS platform. The MSME vendors can avail the TReDS facility, if they want to.

40.7 Interest payment on delayed payments to MSME is payable in line with Micro, Small and Medium Enterprises Development Act, 2006.

41 AHR ITEMS

In item rate contract where the quoted rates for the items exceed 50% of the estimate rates, such items will be considered as Abnormally High Rates (AHR) items and payment of AHR items beyond the SOR stipulated quantities shall be made at the lowest amongst the following rates:

- I. Rates as per SOR, quoted by the Contractor.
- II. Rate of the item, which shall be derived as follows:
 - a. Based on rates of Machine and labour as available from the contract (which includes contractor's supervision, profit, overheads and other expenses).
 - b. In case rates are not available in the contract, rates will be calculated based on prevailing market rates of machine, material and labour plus 15% to cover contractor's supervision profit, overhead & other expenses..

42 VENDOR PERFORMANCE EVALUATION

Shall be as stipulated Annexure II to ITB herewith.

43 INCOME TAX & CORPORATE TAX

43.1 Income tax deduction shall be made from all payments made to the contractor as per the rules and regulations in force and in accordance with the Income Tax Act prevailing from time to time.

43.2 Corporate Tax liability, if any, shall be to the contractor's account.

43.3 TDS

- (i) TDS, wherever applicable, shall be deducted as per applicable act/law/rule.
- (ii) **Higher rate of TDS for non-filers of ITR**

As per Section 206AB of Income Tax Act, 1961, in case of any vendor/customer who does not filed their Income Tax Return for both of the two previous years preceding to current year and aggregate amount of TDS is more than or equal to 50,000/- in each of those previous two years (or limit defined by Govt. from time to time), then TDS will be deducted at the higher of following rates:

- (I) Twice the rate mentioned in relevant TDS section.
- (II) Twice the rate or rates in force
- (III) 5%

43.4 **MENTIONING OF PAN NO. IN INVOICE/BILL**

As per CBDT Notification No. 95/2015 dated 30.12.2015, mentioning of PAN no. is mandatory for procurement of goods / services/works/consultancy services exceeding Rs. 2 Lacs per transaction or as amended from time to time.

Accordingly, contractor should mention their PAN no. in their invoice/ bill for any transaction exceeding Rs. 2 lakhs or as amended from time to time. As provided in the notification, in case contractor do not have PAN no., they have to submit declaration in Form 60 along with invoice/ bill for each transaction.

Payment of contractor shall be processed only after fulfilment of above requirement.

44. **DISPUTE RESOLUTION MECHANISM**

44.1 **QUARTERLY CLOSURE OF THE CONTRACT**

During execution of orders, various issues may arise. In order to timely detect and to address the contractual issue(s) during the execution of contracts, TFL has introduced a mechanism of Quarterly Closure of the contract, under which all the related issues /disputes will be monitored and addressed on quarterly basis for resolution. Vendor (hereinafter referred 'Vendor') should first refer any issues/disputes to Engineer-in-Charge(EIC) for LOA/contracts/ Dealing C&P Executive for Purchase Orders and co-operate them for smooth execution of the contract and to timely address the issues, if any. For applicability of 'Quarterly Closure', please refer BDS.

44.2 **ARBITRATION**

All issue(s)/dispute(s) excluding the matters that have been specified as excepted matters and listed at clause no. 2.6 and which cannot be resolved through Conciliation, such issue(s)/dispute(s) shall be referred to arbitration for adjudication by Sole Arbitrator.

The party invoking the Arbitration shall have the option to either opt for Ad-hoc Arbitration as provided at Clause 2.1 below or Institutionalized Arbitration as provided at Clause 2.2 below, the remaining clauses from 2.3 to 2.7 shall apply to both Ad-hoc and Institutional Arbitration:-

2.1 On invocation of the Arbitration clause by either party, TFL shall suggest a panel of three independent and distinguished persons (Retd Supreme Court & High Court Judges only) to the other party from the Panel of Arbitrators maintained by 'Delhi International Arbitration Centre (DIAC) to select any one among them to act as the Sole Arbitrator. In the event of failure of the other party to select the Sole Arbitrator within 30 days from the receipt of the communication from TFL suggesting the panel of arbitrators, the right of selection of the sole arbitrator by the other party shall stand forfeited and TFL shall appoint the Sole Arbitrator from the suggested panel of three Arbitrators for adjudication of dispute(s). The decision of TFL on the appointment of the sole arbitrator shall be final and binding on the other party. The fees payable to Sole Arbitrator shall be governed by the fee Schedule of "Delhi International Arbitration Centre".

OR

2.2 If a dispute arises out of or in connection with this contract, the party invoking the Arbitration shall submit that dispute to any one of the Arbitral Institutions i.e ICADR/ICA/DIAC/SFCA and that dispute shall be adjudicated in accordance with their respective Arbitration Rules. The matter shall be adjudicated by a Sole Arbitrator who shall necessarily be a Retd. Supreme Court/High Court Judge to be appointed/nominated by the respective institution. The cost/expenses pertaining to the said Arbitration shall also be governed in accordance with the Rules of the respective Arbitral Institution. The decision of the party invoking the Arbitration for reference of dispute to a specific Arbitral institution for adjudication of that dispute shall be final and binding on both the parties and shall not be subject to any change thereafter. The institution once selected at the time of invocation of dispute shall remain unchanged.

2.3 The cost of arbitration proceedings shall be shared equally by the parties.

2.4 The Arbitration proceedings shall be in English language and the seat, venue and place of Arbitration shall be New Delhi, India only.

2.5 Subject to the above, the provisions of Arbitration & Conciliation Act 1996 and any amendment thereof shall be applicable. All matter relating to this Contract and arising out of invocation of Arbitration clause are subject to the exclusive jurisdiction of the Court(s) situated at New Delhi.

2.6 List of Excepted matters:

- a) Dispute(s)/issue(s) involving claims below Rs 25 lakhs and above Rs 25 crores.
- b) Dispute(s)/issue(s) relating to indulgence of Contractor/Vendor/Bidder in corrupt/fraudulent/collusive/coercive practices and/or the same is under investigation by CBI or Vigilance or any other investigating agency or Government.
- c) Dispute(s)/issue(s) wherein the decision of Engineer-In-Charge/owner/TFL has been made final and binding in terms of the Contract.

2.7. Disputes involving claims below Rs 25 Lakhs and above Rs. 25 crores:- Parties mutually agree that dispute(s)/issue(s) involving claims below Rs 25 Lakhs and above Rs 25 crores shall not be subject matter of Arbitration and are subject to the exclusive jurisdiction of the Court(s) situated at New Delhi.

44.3 GOVERNING LAW AND JURISDICTION:

The Contract shall be governed by and construed in accordance with the laws in force in India. The Parties hereby submit to the exclusive jurisdiction of the Courts situated at New Delhi for adjudication of disputes, injunctive reliefs, actions and proceedings, if any, arising out of this Contract.

45. DISPUTES BETWEEN CPSE'S/ GOVERNMENT DEPARTMENT'S / ORGANIZATIONS

Subject to conciliation as provided above, in the event of any dispute (other than those related to taxation matters) or difference relating to the interpretation and application of the provisions of commercial contract(s) between Central Public Sector Enterprises (CPSEs)/ Port Trusts inter se and also between CPSEs and Government Departments /Organizations , such dispute or difference shall be taken up by either party for resolution only through AMRCD as mentioned in OPE OM No. 4(1)/2013-DPE(GM)/FTS-1835 dated 22-05-2018.

Any party aggrieved with the decision of the Committee at the First level (tier) may prefer an appeal before the Cabinet Secretary at the Second level (tier) within 15 days from the date of receipt of decision of the Committee at First level, through it's administrative Ministry/Department, whose decision will be final and binding on all concerned.

The above provisions mentioned at clause no. 44 & 45 shall supersede provisions relating to Conciliation, Arbitration, Governing Law & Jurisdiction and Disputes between CPSE's/ Government Department's/ Organizations mentioned in General Conditions of Contract (GCC) and elsewhere in tender document.

46 INAM-PRO (PLATFORM FOR INFRASTRUCTURE AND MATERIALS PROVIDERS)

INAM-Pro (Platform for infrastructure and materials providers) is a web based platform for infrastructure provides and materials suppliers and was developed by Ministry of Road Transport and Highways (MoRT&H) with a view to reduce project execution delays on account of supply shortages and inspire greater confidence in contractors to procure cement to start with directly from the manufacturers. Presently, numerous cement companies are registered in the portal and offering cement for sale on the portal with a commitment period of 3 years. These companies have bound themselves by ceiling rates for the entire commitment period, wherein they are allowed to reduce or increase their cement rates any number of times within the ceiling rate, but are not permitted to exceed the said ceiling rate.

MoRT&H is expanding the reach of this web-portal by increasing both the product width as well as the product depth. They are working on incorporating 60 plus product categories. The product range will span from large machineries like Earth Movers and Concrete Mixers, to even the smallest items like road studs. MoRT&H intend to turn it into a portal which services every infrastructure development related need of a modern contractor.

TFL's contractors may use this innovative platform, wherever applicable. The usage of web – Portal is a completely voluntary exercise. The platform, however, can serve as a benchmark for comparison of offered prices and products.

47 **PROMOTION OF PAYMENT THROUGH CARDS AND DIGITAL MEANS**

To promote cashless transactions, the onward payments by Contractors to their employees, service providers, sub-contractors and suppliers may be made through Cards and Digital means to the extent possible

48 **CONTRACTOR TO ENGAGE CONTRACT MANPOWER BELONGING TO SCHEDULED CASTES AND WEAKER SECTIONS OF THE SOCIETY**

While engaging the contractual manpower, Contractors are required to make efforts to provide opportunity of employment to the people belonging to Scheduled Castes and weaker sections of the society also in order to have a fair representation of these sections.

49 **PROVISIONS FOR STARTUPS (AS DEFINED IN GAZETTE NOTIFICATION NO. D.L-33004/99 DATED 18.02.2016 AND 23.05.2017 OF MINISTRY OF COMMERCE AND INDUSTRY AND AS AMENDED FROM TIME TO TIME) [FOR APPLICABILITY REFER BDS]**

As mentioned in Section-II, Technical and Financial BEC shall be applicable for all Startups [whether Micro & Small Enterprises (MSEs) or otherwise].

Further, the Startups are also exempted from submission of EMDs (if applicable).

If a Startup emerge lowest bidder, the LoA on such Startup shall be placed for entire tendered quantity/group/item/part (as the case may be). However, during the Kick of Meeting monthly milestones/ check points would be drawn. Further, the performance of such contractor/ service provider will be reviewed more carefully and action to be taken as per provision of contract in case of failure/ poor performance.

50 **PROVISION REGARDING INVOICE FOR REDUCED VALUE OR CREDIT NOTE TOWARDS MAD**

MAD is the reduction in the consideration / contract value for the / services covered under this contract. In case of delay in execution of service provider should raise invoice for reduced value as per MAD) clause. If service provider has raised the invoice for full value, then service provider should issue Credit Note towards the applicable MAD amount with applicable taxes.

In such cases if service provider fails to submit the invoice with reduced value or does not issue credit note as mentioned above, TFL will release the payment to service provider after giving effect of the MAD clause with corresponding reduction of taxes charged on service provider's invoice, to avoid delay in payment.

In case any financial implication arises on TFL due to issuance of invoice without reduction in price or non-issuance of Credit Note, the same shall be to the account of service provider. TFL shall be entitled to deduct / setoff / recover such GST amount (CGST & SGST/UTGST or IGST) together with penalties and interest, if any, against any amounts paid or becomes payable by OWNER in future to the service provider's under this contract or under any other contract.

51. UNIQUE DOCUMENT IDENTIFICATION NUMBER BY PRACTICING CHARTERED ACCOUNTANTS

Practicing Chartered Accountants shall generate Unique Document Identification Number (UDIN) for all certificates issued by them as per provisions of Tender Document.

However, UDIN may not be required for documents being attested by Chartered Accountants in terms of provisions of Tender Document.

52. PROVISION FOR PROCUREMENT FROM A BIDDER WHICH SHARES A LANDBORDER WITH INDIA.

The clause regarding provision for procurement from a bidder which shares a land with India is enclosed as Annexure-VII to ITB herewith.

PROCEDURE FOR ACTION IN CASE CORRUPT/FRAUDULENT/COLLUSIVE/COERCIVE PRACTICES

Annexure-I

A Definitions:

A.1 “Corrupt Practice” means the offering, giving, receiving or soliciting, directly or indirectly, anything of value to improperly influence the actions in selection process or in contract execution.

“Corrupt Practice” also includes any omission for misrepresentation that may mislead or attempt to mislead so that financial or other benefit may be obtained or an obligation avoided.

A.2 “Fraudulent Practice” means and include any act or omission committed by a agency or with his connivance or by his agent by misrepresenting/ submitting false documents and/ or false information or concealment of facts or to deceive in order to influence a selection process or during execution of contract/ order.

A.3 “Collusive Practice amongst bidders (prior to or after bid submission)” means a scheme or arrangement designed to establish bid prices at artificial non-competitive levels and to deprive the Employer of the benefits of free and open competition.

A.4 “Coercive practice” means impairing or harming or threatening to impair or harm directly or indirectly, any agency or its property to influence the improperly actions of an agency, obstruction of any investigation or auditing of a procurement process.

A.5 “Vendor/Supplier/Contractor/Consultant/Bidder” is herein after referred as “Agency”

A.6 “Appellate Authority” shall mean Committee of Directors consisting of Director (Finance) and Director (BD) for works centers under Director (Projects). For all other cases committee of Directors shall consist of Director (Finance) & Director (Projects).

A.7 “Competent Authority” shall mean the authority, who is competent to take final decision for Suspension of business dealing with an Agency/ (ies) and Banning of business dealings with Agency/ (ies) and shall be the “Director” concerned.

A.8 “Allied Agency” shall mean all concerns which come within the sphere of effective influence of the banned/suspended agency shall be treated as allied agency. In determining this, the following factors may be taken into consideration:

- a) Whether the management is common;
- b) Majority interest in the management is held by the partners or directors of banned/ suspended agency;
- c) Substantial or majority shares are owned by the banned/ suspended agency and by virtue of this it has a controlling voice.

d) Directly or indirectly controls, or is controlled by or is under common control with another bidder.

e) All successor agency will also be considered as allied agency.

A.9 "Investigating Agency" shall mean any department or unit of TFL investigating into the conduct of Agency/ party and shall include the Vigilance Department of the TFL, Central Bureau of Investigation, State Police or any other agency set up by the Central or state government having power to investigate.

A.10 "Obstructive practice": materially impede the procuring entity's investigation into allegations of one or more of the above mentioned practices either by deliberately destroying, falsifying, altering; or by concealing of evidence material to the investigation; or by making false statements to investigators and/ or by threatening, harassing or intimidating any party to prevent it from disclosing its knowledge of matters relevant to the investigation or from pursuing the investigation; or by impeding TFL's rights of audit or access to information.

B Actions against bidder(s) indulging in corrupt /fraudulent/ collusive/ coercive practice

B.1 Irregularities noticed during the evaluation of the bids :

If it is observed during bidding process/ bids evaluation stage that a bidder has indulged in corrupt/fraudulent /collusive/coercive practice, the bid of such Bidder (s) shall be rejected and its Earnest Money Deposit (EMD) shall be forfeited.

Further, such agency shall be banned for future business with TFL for a period specified in para B 2.2 below from the date of issue of banning order.

B.2 Irregularities noticed after award of contract

(i) During execution of contract:

If an agency, is found to have indulged in corrupt/fraudulent/ collusive/coercive practices, action shall be initiated for putting the agency on banning list.

After conclusion of process and issuance of Speaking order for putting party on banning list, the order (s)/ contract (s) where it is concluded that such irregularities have been committed shall be terminated and Contract cum Performance Bank Guarantee (CPBG) submitted by agency against such order (s)/ contract (s) shall also be forfeited. Further such order/ contract will be closed following the due procedure in this regard.

The amount that may have become due to the contractor on account of work already executed by him shall be payable to the contractor and this amount shall be subject to adjustment against any amounts due from the contractor under the terms of the contract. No risk and cost provision will be enforced in such cases.

Suspension of order/ contract:

Further, only in the following situations, the concerned order (s)/ contract(s) (where Corrupt/Fraudulent/ Collusive/ Coercive Practices are observed) and payment shall be suspended after issuance of Suspension cum Show Cause Notice:

- (i) Head of Corporate Vigilance Department/CVO based on the investigation by them, recommend for specific immediate action against the agency.
- (ii) Head of Corporate Vigilance Department/CVO based on the input from investigating agency, forward for specific immediate action against the agency.

Suspension cum Show Cause Notice being issued in above cases after approval of the competent authority (as per provisions mentioned under Clause no. D) shall also include the provision for suspension of Order (s)/ Contract (s) and payment. Accordingly, after issuance of Suspension cum Show Cause Notice, the formal communication for suspension of Order (s)/ Contract (s) and payment with immediate effect will be issued by the concerned person of TFL.

During suspension, Contractor/ Service Providers will be allowed to visit the plant/ site for upkeep of their items/ equipment, TFL's issued materials (in case custody of same is not taken over), demobilizing the site on confirmation of EIC, etc.

In addition to above, Recovery of payments (other than due payments) including balance advance payments, if any, made by along with interest thereon at the prevailing rate shall be recovered.

(ii) After execution of contract and during Defect liability period (DLP)/ Warranty/Guarantee Period:

If an agency is found to have indulged in corrupt/fraudulent/ collusive/coercive practices, after execution of contract and during DLP/ Warranty/Guarantee Period, the agency shall be banned for future business with TFL for a period specified in para B 2.2 below from the date of issue of banning order.

Further, the Contract cum Performance Bank Guarantee (CPBG)/Contract Performance Security (CPS) submitted by agency against such order (s)/ contract (s) shall be forfeited.

(iii) After expiry of Defect liability period (DLP)/ Warranty/Guarantee Period

If an agency is found to have indulged in corrupt/fraudulent/ collusive/coercive practices, after expiry of Defect liability period (DLP)/ Warranty/Guarantee Period, the agency shall be banned for future business with TFL for a period specified in para B 2.2 below from the date of issue of banning order.

B.2.2 Period of Banning

The period of banning of agencies indulged in Corrupt/Fraudulent/Collusive/Coercive Practices shall be as under and to be reckoned from the date of banning order:

S. No.	Description	Period of banning from the date of issuance of Banning order
1	Misrepresentation/False information other than pertaining to BEC of tender but having impact on the	06 months

	<p>selection process.</p> <p>For example, if an agency confirms not being in holiday in TFL/PSU's PMC or banned by PSUs/ Govt. Dept., liquidation, bankruptcy & etc. and subsequently it is found otherwise, such acts shall be considered in this category.</p>	
2	<p>Corrupt/Fraudulent (except mentioned sl. no. 1 above) /Collusive/Coercive Practices</p> <p>If an agency again commits Corrupt/Fraudulent (except mentioned sl. no. 1 above) /Collusive/ Coercive Practices in subsequent cases after their banning, such situation of repeated offense to be dealt with more severity</p>	2 years (in addition to the period already served)
2.1		
3	Indulged in unauthorized disposal of materials provided by TFL	2 years
4	If act of vendor/ contractor is a threat to the National Security	2 years

C Effect of banning on other ongoing contracts/ tenders

- C.1 If an agency is put on Banning, such agency should not be considered in ongoing tenders/future tenders.
- C.2 However, if such an agency is already executing other order (s)/ contract (s) where no corrupt/fraudulent/ collusive/coercive practice is found, the agency should be allowed to continue till its completion without any further increase in scope except those incidental to original scope mentioned in the contract.
- C.3 If an agency is put on the Banning List during tendering and no irregularity is found in the case under process:
 - C.3.1 after issue of the enquiry /bid/tender but before opening of Technical bid, the bid submitted by the agency shall be ignored.
 - C.3.2 after opening Technical bid but before opening the Price bid, the Price bid of the agency shall not be opened and BG/EMD submitted by the agency shall be returned to the agency.
 - C.3.3 after opening of price, BG/EMD made by the agency shall be returned; the offer of the agency shall be ignored & will not be further evaluated. . In case such agency is lowest (L-1), next lowest bidder shall be considered as L-1

D. Procedure for Suspension of Bidder

D.1 Initiation of Suspension

Action for suspension business dealing with any agency/(ies) shall be initiated by Corporate C&P Department when

- (i) Corporate Vigilance Department based on the fact of the case gathered during investigation by them recommend for specific immediate action against the agency.
- (ii) Corporate Vigilance Department based on the input from Investigating agency, forward for specific immediate action against the agency.
- (iii) Non performance of Vendor/Supplier/Contractor/Consultant leading to termination of Contract/ Order.

D.2 Suspension Procedure:

- D.2.1 The order of suspension would operate initially for a period not more than six months and is to be communicated to the agency and also to Corporate Vigilance Department. Period of suspension can be extended with the approval of the Competent Authority by one month at a time with a ceiling of six months pending a conclusive decision to put the agency on banning list.
- D.2.2 During the period of suspension, no new business dealing may be held with the agency.
- D.2.3 Period of suspension shall be accounted for in the final order passed for banning of business with the agency.
- D.2.4 The decision regarding suspension of business dealings should also be communicated to the agency.
- D.2.5 If a prima-facie, case is made out that the agency is guilty on the grounds which can result in banning of business dealings, proposal for issuance of suspension order and show cause notice shall be put up to the Competent Authority. The suspension order and show cause notice must include that (i) the agency is put on suspension list and (ii) why action should not be taken for banning the agency for future business from TFL. The competent authority to approve the suspension will be same as that for according approval for banning.

D 3 Effect of Suspension of business:

Effect of suspension on other on-going/future tenders will be as under:

- D.3.1 No enquiry/bid/tender shall be entertained from an agency as long as the name of agency appears in the Suspension List.
- D.3.2 If an agency is put on the Suspension List during tendering:
 - D.3.2.1 after issue of the enquiry /bid/tender but before opening of Technical bid, the bid submitted by the agency shall be ignored.
 - D.3.2.2 after opening Technical bid but before opening the Price bid, the Price bid of the agency shall not be opened and BG/EMD submitted by the agency shall be returned to the agency.
 - D.3.2.3 after opening of price, BG/EMD made by the agency shall be returned; the offer of the agency shall be ignored & will not be further evaluated. . In case such agency is lowest (L-1), next lowest bidder shall be considered as L-1D.3.3 The existing contract (s)/ order (s) under execution shall continue.
- D.3.4 Tenders invited for procurement of goods, works and services shall have provision that the bidder shall submit a undertaking to the effect that (i) neither the bidder themselves nor their allied agency/(ies) are on banning list of TFL and(ii) bidder is not banned by any Government department/ Public Sector.

F. Appeal against the Decision of the Competent Authority:

- F.1 The agency may file an appeal against the order of the Competent Authority for putting the agency on banning list. The appeal shall be filed to Appellate Authority. Such an appeal shall be preferred within one month from the of receipt of banning order.
- F.2 Appellate Authority would consider the appeal and pass appropriate order which shall be communicated to the party as well as the Competent Authority.
- F.3 Appeal process may be completed within 45 days of filing of appeal with the Appellate Authority.

- G. Wherever there is contradiction with respect to terms of 'Integrity pact' , GCC and 'Procedure for action in case of Corrupt/Fraudulent/ Collusive/Coercive Practice', the provisions of 'Procedure for action in case of Corrupt/Fraudulent/ Collusive/Coercive Practice' shall prevail.

**PROCEDURE FOR EVALUATION OF PERFORMANCE OF VENDORS/ SUPPLIERS/
CONTRACTORS/ CONSULTANTS**

1.0 **GENERAL**

A system for evaluation of Vendors/ Suppliers/Contractors/ Consultants and their performance is a key process and important to support an effective purchasing & contracting function of an organization.

Performance of all participating Vendors/ Suppliers/Contractors/ Consultants need to be closely monitored to ensure timely receipt of supplies from a Vendor, completion of an assignment by a Consultant or complete execution of order by a contractor within scheduled completion period. For timely execution of projects and meeting the operation & maintenance requirement of operating plants, it is necessary to monitor the execution of order or contracts right from the award stage to completion stage and take corrective measures in time.

2.0 **OBJECTIVE**

The objective of Evaluation of Performance aims to recognize, and develop reliable Vendors/ Suppliers/Contractors/ Consultants so that they consistently meet or exceed expectations and requirements.

The purpose of this procedure is to put in place a system to monitor performance of Vendors/ Suppliers/Contractors/ Consultants associated with TFL so as to ensure timely completion of various projects, timely receipt of supplies including completion of works & services for operation and maintenance of operating plants and quality standards in all respects.

3.0 **METHODOLOGY**

- i) **Preparation of Performance Rating Data Sheet**
Performance rating data Sheet for each and every Vendor/ Supplier/Contractor/Consultant for all orders/Contracts with a value of Rs. 50 Lakhs and above is recommended to be drawn up. Further, Performance rating data Sheet for orders/contracts of Vendor/Supplier/Contractor/ Consultant who are on watch list/holiday list/ banning list shall be prepared irrespective of order/ contract value. These data sheets are to be separately prepared for orders/ contracts related to Projects and O&M. Format, Parameters, Process, responsibility for preparation of Performance Rating Data Sheet are separately mentioned.
- ii) **Measurement of Performance**
Based on the parameters defined in Data Sheet, Performance of concerned Vendor/ Supplier/Contractor/ Consultant would be computed and graded accordingly. The measurement of the performance of the Party would be its ability to achieve the minimum scoring of 60% points in the given parameters.
- iii) **Initiation of Measures:**
Depending upon the Grading of Performance, corrective measures would be initiated by taking up the matter with concerned Vendor/ Supplier/Contractor/ Consultant. Response of Vendor/ Supplier/Contractor/ Consultant would be considered before deciding further course of action.

- iv) Implementation of Corrective Measures:
Based on the response of Vendor/ Supplier/Contractor/ Consultant, concerned Engineer-in-Charge for the Projects and/or OIC in case of O&M would recommend for continuation or discontinuation of such party from the business of TFL.
- v) Orders/contracts placed on Proprietary/OEM basis for O&M will be evaluated and, if required, corrective action will be taken for improvement in future.

4.0 **EXCLUSIONS:**

The following would be excluded from the scope of evaluation of performance of Vendors/ Suppliers/Contractors/ Consultants :

- i) Orders/Contracts below the value of Rs. 50 Lakhs if Vendor/ Supplier/Contractor/ Consultant is not on watch list/ holiday list/ banning list.
- ii) Orders for Misc./Administrative items/ Non stock Non valued items (PO with material code ending with 9).

However, concerned Engineer-in-Charge /OICs will continue to monitor such cases so as to minimize the impact on Projects/O&M plants due to non performance of Vendors/ Suppliers/Contractors/ Consultants in all such cases.

5.0 **PROCESS OF EVALUATION OF PERFORMANCE OF VENDORS/ SUPPLIERS/ CONTRACTORS/ CONSULTANTS**

5.1 FOR PROJECTS

- i) Evaluation of performance of Vendors/ Suppliers/Contractors/ Consultants in case of PROJECTS shall be done immediately with commissioning of any Project.
- ii) On commissioning of any Project, EIC (Engineer-in-charge)/ Project-in-charge shall prepare a Performance Rating Data Sheet (Format at Annexure-1) for all Orders and Contracts.
- iii) Depending upon the Performance Rating, following action shall be initiated by Engineer-in-charge/Project-in-charge:

Sl.No.	Performance Rating	Action
1	POOR	Seek explanation for Poor performance
2	FAIR	Seek explanation for Fair performance
3	GOOD	Letter to the concerned for improving performance in future
4	VERY GOOD	No further action

- iv) Reply from concerned Vendor/ Supplier/Contractor/ Consultant shall be examined. In case of satisfactory reply, Performance Rating data Sheet to be closed with a letter to the concerned for improving performance in future.
- v) When no reply is received or reasons indicated are unsatisfactory, the following actions need to be taken:

A) Where performance rating is "POOR" (as per Performance Rating carried out after execution of Order/ Contract and where no reply/ unsatisfactory reply is received from party against the letter seeking the explanation from Vendor/Supplier/Contractor/ Consultant along with sharing the performance rating)

Recommend such defaulting Vendor / Supplier / Contractor / Consultant for the following action:

1. Poor Performance on account of Quality (if marks obtained against Quality parameter is less than 20):

(a) **First Instance: Holiday (Red Card) for one Years**

(b) **Subsequent instance (s) in other ongoing order (s)/ contract (s) or new order (s) /contact (s) on such Vendor/ Supplier/ Contractor/ Consultant: Holiday (Red Card) for two Years**

2. Poor Performance on account of other than Quality (if marks obtained against Quality parameter is more than 20):

(a) **First such instance: Advisory notice (Yellow Card)** shall be issued and Vendor/Supplier/Contractor/ Consultant shall be put on watch list for a period of Two (2) Years.

(b) **Second such instance in other ongoing order (s)/ contract (s) or new order (s) /contact (s) on such Vendor/ Supplier/ Contractor/ Consultant: Putting on Holiday (Red Card) for a period of One Year**

(c) **Subsequent instances (more than two) in other ongoing order (s)/ contract (s) or new order (s) /contact (s) on such Vendor/ Supplier/ Contractor/ Consultant: Putting on Holiday (Red Card) for a period of Two Years.**

B) Where Poor/Non-Performance leading to termination of contract or Offloading of contract due to poor performance attributable to Vendor/Supplier/ Contractor/Consultant (under clause no. 34.2.3 of GCC)

(a) **First instance: Advisory notice (Yellow Card)** shall be issued and Vendor/Supplier/Contractor /Consultant shall be put on watch list for a period of Two (2) Years.

Further such vendor will not be allowed to participate in the re-tender of the same supply/work/services of that location which has terminated / offloaded. Moreover, it will be ensured that all other action as per provision of contract including forfeiture of Contract Performance Security (CPS) etc. are undertaken.

However, such vendor will be allowed to participate in all other tenders and to execute other ongoing order/ contract (s) or new contract/ order (s).

The Yellow card will be automatically revoked after a period of two years unless the same is converted into Red Card due to subsequent instances of poor/ non-performance in other ongoing order (s)/ contract (s) or new order (s) /contact (s) on such Vendor/ Supplier/ Contractor/ Consultant.

- (b) **Second instances** in other ongoing order (s)/ contract (s) or new order (s) /contact (s) on such Vendor/ Supplier/ Contractor/ Consultant: **Holiday (Red Card)** for period of One Year and they shall also to be considered for Suspension.
- (c) **Subsequent instances (more than two)** in other ongoing order (s)/ contract (s) or new order (s) /contact (s) on such Vendor/ Supplier/ Contractor/ Consultant: **Holiday (Red Card) for period of Two Years and they shall also to be considered for Suspension.**

(C) Where Performance rating is “FAIR”:

Issuance of warning to such defaulting Vendor/ Supplier/Contractor/ Consultant to improve their performance.

5.2 FOR CONSULTANCY JOBS

Monitoring and Evaluation of consultancy jobs will be carried out in the same way as described in para 5.1 for Projects.

5.3 FOR OPERATION & MAINTENANCE

- i) Evaluation of performance of Vendors/ Suppliers/Contractors/ Consultants in case of Operation and Maintenance shall be done immediately after execution of order/ contract.
- ii) After execution of orders a Performance Rating Data Sheet (Format at Annexure-2) shall be prepared for Orders by Site C&P and for Contracts/Services by respective Engineer-In-Charge.
- iii) Depending upon Performance Rating, following action shall be initiated by EIC:

Sl. No.	Performance Rating	Action
1	POOR	Seek explanation for Poor performance
2.	FAIR	Seek explanation for Fair performance
3	GOOD	Letter to the concerned for improving performance in future.
4	VERY GOOD	No further action

- iv) Reply from concerned Vendor/ Supplier/Contractor/ Consultant shall be examined. In case of satisfactory reply, Performance Rating data Sheet to be closed with a letter to the concerned for improving performance in future.
- v) When no reply is received or reasons indicated are unsatisfactory, the following actions need to be taken:

- A) Where performance rating is "POOR" (as per Performance Rating carried out after execution of Order/ Contract and where no reply/ unsatisfactory reply is received from party against the letter seeking the explanation from Vendor/Supplier/Contractor/ Consultant along with sharing the performance rating)

Recommend such defaulting Vendor / Supplier / Contractor / Consultant for the following action:

1. Poor Performance on account of Quality (if marks obtained against Quality parameter is less than 20):
 - (a) **First Instance: Holiday (Red Card) for one Year**
 - (b) **Subsequent instance (s) in other ongoing order (s)/ contract (s) or new order (s) /contact (s) on such Vendor/ Supplier/ Contractor/ Consultant: Holiday (Red Card) for Two Years**
2. Poor Performance on account of other than Quality (if marks obtained against Quality parameter is more than 20):
 - (a) **First such instance: Advisory notice (Yellow Card)** shall be issued and Vendor/Supplier/Contractor/ Consultant shall be put on watch list for a period of Two (2) Years.
 - (b) **Second such instance in other ongoing order (s)/ contract (s) or new order (s) /contact (s) on such Vendor/ Supplier/ Contractor/ Consultant: Putting on Holiday (Red Card) for a period of One Year**
 - (c) **Subsequent instances (more than two) in other ongoing order (s)/ contract (s) or new order (s) /contact (s) on such Vendor/ Supplier/ Contractor/ Consultant: Putting on Holiday (Red Card) for a period of Two Years.**

- B) Where Poor/Non-Performance leading to termination of contract or Offloading of contract due to poor performance attributable to Vendor/Supplier/ Contractor/Consultant (under clause no. 34.2.3 of GCC)

- (a) **First instance: Advisory notice (Yellow Card)** shall be issued and Vendor/Supplier/Contractor /Consultant shall be put on watch list for a period of two (2) Years.

Further such vendor will not be allowed to participate in the re-tender of the same supply/work/services of that location which has terminated / offloaded. Moreover, it will be ensured that all other action as per provision of contract including forfeiture of Contract Performance Security (CPS) etc. are undertaken.

However, such vendor will be allowed to participate in all other tenders and to execute other ongoing order/ contract (s) or new contract/ order (s).

The Yellow card will be automatically revoked after a period of two years unless the same is converted into Red Card due to subsequent instances of poor/ non-performance in other ongoing order (s)/ contract (s) or new order (s) /contact (s) on such Vendor/ Supplier/ Contractor/ Consultant.

(b) **Second instances** in other ongoing order (s)/ contract (s) or new order (s) /contact (s) on such Vendor/ Supplier/ Contractor/ Consultant: **Holiday (Red Card)** for period of One Year and they shall also to be considered for Suspension.

(c) **Subsequent instances (more than two)** in other ongoing order (s)/ contract (s) or new order (s) /contact (s) on such Vendor/ Supplier/ Contractor/ Consultant: **Holiday (Red Card) for period of Two Years and they shall also to be considered for Suspension.**

(C) Where Performance rating is "FAIR"
Issuance of warning to such defaulting Vendors/Contractors/Consultants to improve their performance.

6.0 **REVIEW & RESTORATION OF PARITES PUT ON HOLIDAY**

6.1 An order for Holiday passed for a certain specified period shall deemed to have been automatically revoked on the expiry of that specified period and it will not be necessary to issue a specific formal order of revocation.

Further, in case Vendor/ Supplier/Contractor/ Consultant is put on holiday due to quality, and new order is placed on bidder after restoration of Vendor/ Supplier/Contractor/ Consultant, such order will be properly monitored during execution stage by the concerned site.

7.0 **EFFECT OF HOLIDAY**

7.1 If a Vendor/ Supplier/Contractor/ Consultant is put on Holiday, such Vendor/ Supplier/Contractor/ Consultant shall not be considered in ongoing tenders/future tenders.

7.2 However, if such Vendor/ Supplier/Contractor/ Consultant is already executing any other order/ contract and their performance is satisfactory in terms of the relevant contract, should be allowed to continue till its completion without any further increase in scope except those incidental to original scope mentioned in the contract. In such a case CPBG will not be forfeited and payment will be made as per provisions of concerned contract. However, this would be without prejudice to other terms and conditions of the contract.

7.3. Effect on other ongoing tendering:

7.3.1 after issue of the enquiry /bid/tender but before opening of Technical bid, the bid submitted by the party shall be ignored.

7.3.2 after opening of price, BG/EMD made by the party shall be returned; the offer of the party shall be ignored & will not be further evaluated. In case such agency is lowest (L-1), next lowest bidder shall be considered as L-1.

7.3.3 after opening of price, BG/EMD made by the party shall be returned; the offer of the party shall be ignored & will not be further evaluated. If errant party emerges as the lowest (L1), then such tender shall also be cancelled and re-invited.

8.0 While putting the Vendor/ Supplier/Contractor/ Consultant on holiday as per the procedure, the holding company, subsidiary, joint venture, sister concerns, group division of the errant Vendor/ Supplier/Contractor/ Consultant shall not be considered for putting on holiday list. Any bidder, put on holiday, will not be allowed to bid through consortium route also in new tender during the period of holiday.

9.0 If an unsuccessful bidder makes any vexatious, frivolous or malicious complaint against the tender process with the intention of delaying or defeating any procurement or causing loss to TFL or any other bidder, such bidder will be put on holiday for a period of six months, if such complaint is proved to be vexatious, frivolous or malicious, after following the due procedure.

10. APPEAL AGAINST THE DECISION OF THE COMPETENT AUTHORITY:

- (a) The party may file an appeal against the order of the Competent Authority for putting the party on Holiday list. The appeal shall be filed to Appellate Authority. Such an appeal shall be preferred within one month from the of receipt of Holiday order.
- (b) Appellate Authority would consider the appeal and pass appropriate order which shall be communicated to the party as well as the Competent Authority.
- (c) Appeal process may be completed within 45 days of filing of appeal with the Appellate Authority.
- (d) "Appellate Authority" shall mean Committee of Directors consisting of Director (Finance) and Director (BD) for works centers under Director (Projects). For all other cases committee of Directors shall consist of Director (Finance) & Director (Projects).

11. ERRANT BIDDER

In case after price bid opening the lowest evaluated bidder (L1) is not awarded the job for any mistake committed by him in bidding or withdrawal of bid or modification of bid or varying any term in regard thereof leading to re-tendering, TFL shall forfeit EMD if paid by the bidder and such bidders shall be debarred from participation in retendering of the same job(s)/item(s).

Further, such bidder will be put on Watch List (Yellow Card) for a period of two years after following the due procedure. However, during the period in watch list such vendor will be allowed to participate in all other tenders and to execute other ongoing order/ contract (s) or new contract/ order (s).

In case of subsequent instances of default in other tender(s) during aforesaid watch list period, the action shall be initiated as per provision of sl. no. 2 of para A of Clause no. 5.1 (v) and 5.3 (v).

The Yellow card will be automatically revoked after specified period unless the same is converted into Red Card

12. In case CBIC (Central Board of Indirect Taxes and Customs)/ any tax authority / any equivalent government agency brings to the notice of TFL that the Supplier has not remitted the amount towards GST (CGST & SGST/UTGST or IGST) collected from TFL to the government exchequer, then, that Supplier shall be put under Holiday list of TFL for period of six months after following the due procedure. This action will be in addition to the right of recovery of financial implication arising on TFL.

**TALCHER FERTILIZERS LIMITED
PERFORMANCE RATING DATA SHEET
(FOR PROJECTS/ CONSULTANCY JOBS)**

- i) Project/Work Centre :
 ii) Order/ Contract No. & date :
 iii) Brief description of Items :
 Works/Assignment
 iv) Order/Contract value (Rs.) :
 v) Name of Vendor/Supplier/ :
 Contractor/ Consultant
 vi) Contracted delivery/ :
 Completion Schedule
 vii) Actual delivery/ :
 Completion date

Performance Parameter	Delivery/ Completion Performance	Quality Performance	Reliability Performance#	Total
Maximum Marks	40	40	20	100
Marks Allotted				

Note:

Remarks (if any)

PERFORMANCE RATING (**)

Note :

(#) Vendor/Supplier/Contractor/Consultant who seek repeated financial assistance or deviation beyond contract payment term or seeking direct payment to the sub-vendor/sub-contractor due to financial constraints, then '0' marks should be allotted against Reliability Performance.

(*) Allocation of marks should be as per enclosed instructions

(**) Performance rating shall be classified as under :

Sl. No.	Range (Marks)	Rating	Signature of Authorised Signatory:
1	60 & below	POOR	Name: Designation:
2	61-75	FAIR	
3	76-90	GOOD	
4	More than 90	VERY GOOD	

Instructions for allocation of marks

1. Marks are to be allocated as under :

1.1	DELIVERY/ COMPLETION PERFORMANCE	40 Marks
	<div style="width: 45%;">Delivery Period/ Completion Schedule</div> <div style="width: 45%;">Delay in Weeks</div>	Marks

a) Upto 3 months	Before CDD	40
	Delay upto 4 weeks	35
	" 8 weeks	30
	" 10 weeks	25
	" 12 weeks	20
	" 16 weeks	15
	More than 16 weeks	0
b) Above 3 months	Before CDD	40
	Delay upto 4 weeks	35
	" 8 weeks	30
	" 10 weeks	25
	" 16 weeks	20
	" 20 weeks	15
	" 24 weeks	10
	More than 24 weeks	0

1.2 QUALITY PERFORMANCE 40 Marks

For Normal Cases : No Defects/ No Deviation/ No failure:		40 marks
i) Rejection/Defects	Marks to be allocated on prorata basis for acceptable quantity as compared to total quantity for normal cases	10 marks
ii) When quality failure endanger system integration and safety of the system	Failure of severe nature - Moderate nature - low severe nature	0 marks 5 marks 10-25 marks
iii) Number of deviations	1. No deviation 2. No. of deviations ≤ 2 3. No. of deviations > 2	5 marks 2 marks 0 marks

1.3 RELIABILITY PERFORMANCE 20 Marks

A.	FOR WORKS/CONTRACTS	
i)	Submission of order acceptance, agreement, PBG, Drawings and other documents within time	4 marks
ii)	Mobilization of resources as per Contract and in time	4 marks
iii)	Liquidation of Check-list points	4 marks
iv)	Compliance to statutory and HS&E requirements or	4 marks

	Reliability of Estimates/Design/Drawing etc. in case of Consultancy jobs	
v)	Timely submission of estimates and other documents for Extra, Substituted & AHR items	4 marks
B.	FOR SUPPLIES	
i)	Submission of order acceptance, PBG, Drawings and other documents within time	5 marks
ii)	Attending complaints and requests for after sales service/ warranty repairs and/ or query/ advice (upto the evaluation period).	5 marks
iii)	Response to various correspondence and conformance to standards like ISO	5 marks
iv)	Submission of all required documents including Test Certificates at the time of supply	5 marks

**TALCHER FERTILIZERS LIMITED
PERFORMANCE RATING DATA SHEET
(FOR O&M)**

- i) Location :
- ii) Order/ Contract No. & date :
- iii) Brief description of Items :
Works/Assignment
- iv) Order/Contract value (Rs.) :
- v) Name of Vendor/Supplier/
Contractor/ Consultant :
- vi) Contracted delivery/
Completion Schedule :
- vii) Actual delivery/
Completion date :

Performance Parameter	Delivery Performance	Quality Performance	Reliability Performance#	Total
Maximum Marks	40	40	20	100
Marks Allocated (*)				

Remarks (if any)

PERFORMANCE RATING ()**

Note :

(#) Vendor/Supplier/Contractor/Consultant who seek repeated financial assistance or deviation beyond contract payment term or seeking direct payment to the sub-vendor/sub-contractor due to financial constraints, then '0' marks should be allotted against Reliability Performance

(*) Allocation of marks should be as per enclosed instructions

(**) Performance rating shall be classified as under :

Sl. No.	Range (Marks)	Rating
1	60 & below	POOR
2	61-75	FAIR
3	76-90	GOOD
4	More than 90	VERY GOOD

Signature of
Authorised Signatory:

Name:

Designation:

Instructions for allocation of marks (For O&M)

1. Marks are to be allocated as under :

1.1 DELIVERY/ COMPLETION PERFORMANCE

40 Marks

Marks

Delivery Period/ Completion Schedule	Delay in Weeks
---	-----------------------

a) Upto 3 months	Before CDD		
	Delay upto 4 weeks	35	40

" 8 weeks	30
" 10 weeks	25
" 12 weeks	20
" 16 weeks	15
More than 16 weeks	0

b) Above 3 months	Before CDD	40
	Delay upto 4 weeks	35
	" 8 weeks	30
	" 10 weeks	25
	" 16 weeks	20
	" 20 weeks	15
	" 24 weeks	10
	More than 24 weeks	0

1.2 QUALITY PERFORMANCE

40 Marks

For Normal Cases : No Defects/ No Deviation/ No failure:		40 marks
i) Rejection/Defects	Marks to be allocated on prorata basis for acceptable quantity as compared to total quantity for normal cases	10 marks
ii) When quality failure endanger system integration and safety of the system	Failure of severe nature - Moderate nature - low severe nature	0 marks 5 marks 10-25 marks
iii) Number of deviations	1. No deviation 2. No. of deviations ≤ 2 3. No. of deviations > 2	5 marks 2 marks 0 marks

1.3 RELIABILITY PERFORMANCE

20 Marks

A.	FOR WORKS/CONTRACTS	
i)	Submission of order acceptance, agreement, PBG, Drawings and other documents within time	4 marks
ii)	Mobilization of resources as per Contract and in time	4 marks
iii)	Liquidation of Check-list points	4 marks
iv)	Compliance to statutory and HS&E requirements or Reliability of Estimates/Design/Drawing etc. in case of Consultancy jobs	4 marks

v)	Timely submission of estimates and other documents for Extra, Substituted & AHR items	4 marks
B.	FOR SUPPLIES	
i)	Submission of order acceptance, PBG, Drawings and other documents within time	5 marks
ii)	Attending complaints and requests for after sales service/ warranty repairs and/ or query/ advice (upto the evaluation period).	5 marks
iii)	Response to various correspondence and conformance to standards like ISO	5 marks
iv)	Submission of all required documents including Test Certificates at the time of supply	5 marks

INSTRUCTIONS FOR SUBMISSION OF BID ONLINE THROUGH CPP PORTAL

1. The bidders are required to submit soft copies of their bids electronically on the CPP Portal, using valid Digital Signature Certificates. The instructions given below are meant to assist the bidders in registering on the CPP Portal, prepare their bids in accordance with the requirements and submitting their bids online on the CPP Portal.
More information useful for submitting online bids on the CPP Portal may be obtained at: <https://eprocure.gov.in/eprocure/app>.

2. **REGISTRATION**

- i. Bidders are required to enroll on the e-Procurement module of the Central Public Procurement Portal (URL: <https://eprocure.gov.in/eprocure/app>) by clicking on the link "Online bidder Enrollment" on the CPP Portal which is free of charge.
- ii. As part of the enrollment process, the bidders will be required to choose a unique username and assign a password for their accounts.
- iii. Bidders are advised to register their valid email address and mobile numbers as part of the registration process. These would be used for any communication from the CPP Portal.
- iv. Bidders are advised to make ensure the accessibility & availability of java software in their system (PC) either download & install the latest version of java software or click on the below link to install the java in their system prior to proceed further.
<https://www.oracle.com/technetwork/java/javase/downloads/index.html>
- v. Upon enrollment, the bidders will be required to register their valid Digital Signature Certificate (Class III Certificates with signing key usage) issued by any Certifying Authority recognized by CCA India (e.g. Sify / nCode / eMudhra etc.), with their profile.
- vi. Only one valid DSC should be registered by a bidder. Please note that the bidders are responsible to ensure that they do not lend their DSC's to others which may lead to misuse.
- vii. Bidder then logs in to the site through the secured log-in by entering their user ID / password and the password of the DSC / e-Token.

3. **SEARCHING FOR TENDER DOCUMENTS**

- i. There are various search options built in the CPP Portal, to facilitate bidders to search active tenders by several parameters. These parameters could include Tender ID, Organization Name, Location, Date, Value, etc. There is also an option of advanced search for tenders, wherein the bidders may combine a number of search parameters such as Organization Name, Form of Contract, Location, Date, Other keywords etc. to search for a tender published on the CPP Portal.

- ii. Once the bidders have selected the tenders they are interested in, they may download the required documents / tender schedules. These tenders can be moved to the respective 'My Tenders' folder. This would enable the CPP Portal to intimate the bidders through SMS / email in case there is any corrigendum issued to the tender document.
- iii. The bidder should make a note of the unique Tender ID assigned to each tender, in case they want to obtain any clarification / help from the Helpdesk.

4. PREPARATION OF BIDS

- i. Bidder should take into account any corrigendum published on the tender document before submitting their bids.
- ii. Please go through the tender advertisement and the tender document carefully to understand the documents required to be submitted as part of the bid. Please note the number of covers in which the bid documents have to be submitted, the number of documents - including the names and content of each of the document that need to be submitted. Any deviations from these may lead to rejection of the bid.
- iii. Bidder, in advance, should get ready the bid documents to be submitted as indicated in the tender document / schedule and generally, they can be in PDF / XLS / RAR / DWF/JPG formats. Bid documents may be scanned with 100 dpi with black and white option which helps in reducing size of the scanned document.
- iv. To avoid the time and effort required in uploading the same set of standard documents which are required to be submitted as a part of every bid, a provision of uploading such standard documents (e.g. PAN card copy, annual reports, auditor certificates etc.) has been provided to the bidders. Bidders can use "My Space" or "Other Important Documents" area available to them to upload such documents. These documents may be directly submitted from the "My Space" area while submitting a bid, and need not be uploaded again and again. This will lead to a reduction in the time required for bid submission process.

Note: My Documents space is only a repository given to the Bidders to ease the uploading process. If Bidder has uploaded his Documents in My Documents space, this does not automatically ensure these Documents being part of Technical Bid.

5. SUBMISSION OF BIDS

- i. Bidder should log into the site well in advance for bid submission so that they can upload the bid in time i.e. on or before the bid submission time. Bidder will be responsible for any delay due to other issues.
- ii. The bidder has to digitally sign and upload the required bid documents one by one as indicated in the tender document.
- iii. Bidder should submit EMD / Declaration for Bid security (as applicable) strictly as per format Form F-2B provided in the NIT. Otherwise the uploaded bid will be rejected.

- iv. Bidders are requested to note that they should necessarily submit their financial bids in the format provided and no other format is acceptable. If the price bid has been given as a standard SOR format with the tender document, then the same is to be downloaded and to be filled by all the bidders. Bidders are required to download the SOR file, open it and complete the white coloured (unprotected) cells with their respective financial quotes and other details (such as name of the bidder). No other cells should be changed. Once the details have been completed, the bidder should save it and submit it online, without changing the filename. If the SOR file is found to be modified by the bidder, the bid will be rejected.
- v. The server time (which is displayed on the bidders' dashboard) will be considered as the standard time for referencing the deadlines for submission of the bids by the bidders, opening of bids etc. The bidders should follow this time during bid submission.
- vi. All the documents being submitted by the bidders would be encrypted using PKI encryption techniques to ensure the secrecy of the data. The data entered cannot be viewed by unauthorized persons until the time of bid opening. The confidentiality of the bids is maintained using the secured Socket Layer 128 bit encryption technology. Data storage encryption of sensitive fields is done. Any bid document that is uploaded to the server is subjected to symmetric encryption using a system generated symmetric key. Further this key is subjected to asymmetric encryption using buyers/bid opener's public keys. Overall, the uploaded tender documents become readable only after the tender opening by the authorized bid openers.
- vii. The uploaded tender documents become readable only after the tender opening by the authorized bid openers.
- viii. Upon the successful and timely submission of bids (i.e. after Clicking "Freeze Bid Submission" in the portal), the portal will give a successful bid submission message & a bid summary will be displayed with the bid no. and the date & time of submission of the bid with all other relevant details.
- ix. The bid summary has to be printed and kept as an acknowledgement of the submission of the bid. This acknowledgement may be used as an entry pass for any bid opening meetings.

6. ASSISTANCE TO BIDDERS

- i. Any queries relating to the tender document and the terms and conditions contained therein should be addressed to the Tender Inviting Authority for a tender or the relevant contact person indicated in the tender.
- ii. Any queries relating to the process of online bid submission or queries relating to CPP Portal in general may be directed to the 24x7 CPP Portal Helpdesk.

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BIDDING DATA SHEET (BDS)

ITB TO BE READ IN CONJUNCTION WITH THE FOLLOWING:

A. GENERAL					
ITB clause	Description				
1.1	The Employer/Owner is: The Employer/Owner is: Talcher Fertilizers Limited				
1.2	The name of the Works/Services to be performed is: “CONSTRUCTION OF 220 KV LILO GIS AT TALCHER FERTILIZERS LTD, ODISHA (INDIA)” .				
3	BIDS FROM CONSORTIUM/ JOINT VENTURE: <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td style="text-align: center;">APPLICABLE</td> <td style="text-align: center;">x</td> </tr> <tr> <td style="text-align: center;">NOT APPLICABLE</td> <td style="text-align: center;">✓</td> </tr> </table>	APPLICABLE	x	NOT APPLICABLE	✓
APPLICABLE	x				
NOT APPLICABLE	✓				
B. BIDDING DOCUMENT					
ITB clause	Description				
8.1	<p>For clarification purposes only, the communication address is: M/s Projects & Development India Limited, P.D.I.L Bhawan, A-14, Sector-1, Noida, (PIN 201301) Dist. GautamBudh Nagar (UP). (India)</p> <p>Kind Attention: Mrs. Anjali Thakur, Dy. General Manager (M.M) Fax no. : +91-120-2529801 Tel no. : +91-120-2529842 E-mail : anjali@pdilin.com alam@pdilin.com</p>				
C. PREPARATION OF BIDS					
ITB clause	Description				
11.1.1 (r)	Additional documents to be submitted by the Bidder with its Part-I (Techno-commercial/ Unpriced bid) :As per SCC/Scope of Work.				
13	<p>Details of Buyer:</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td style="text-align: center;">Services to be rendered at</td> <td>M/s Talcher Fertilizers Ltd. (TFL), Administrative Building, Talcher, Post: Vikrampur, Dist: Angul, Pincode-759106, Odisha</td> </tr> </table>	Services to be rendered at	M/s Talcher Fertilizers Ltd. (TFL), Administrative Building, Talcher, Post: Vikrampur, Dist: Angul, Pincode-759106, Odisha		
Services to be rendered at	M/s Talcher Fertilizers Ltd. (TFL), Administrative Building, Talcher, Post: Vikrampur, Dist: Angul, Pincode-759106, Odisha				

	PAN No.	AAFCT8667A	
	GST no.	21AAFCT8667A1ZH	
14	The currency of the Bid shall be INR		
15	The bid validity period shall be 90 days from final 'Bid Due Date'.		
16.1, 16.10 and 38.6	<p>In case 'Earnest Money / Bid Security' or "Contract Performance Security" is in the form of 'Demand Draft' or 'Banker's Cheque', the same should be favour of "Talcher Fertilizers Limited", payable at New Delhi.</p> <p>In case of submission through online banking transaction i.e. IMPS / NEFT / RTGS / SWIFT, etc, the details of TFL's Bank account are as under:</p> <p>Account Holder's Name: Talcher Fertilizers Limited Bank Name: State Bank of India Branch: CAG II, New Delhi Account number: 41256023769 Type (Current/Saving): Current Branch Code-17313 Bidder to mention reference no. "EMD/....." in narration while remitting the EMD / Bid Security amount and to mention reference no. "CPS/....." in narration while remitting the CPS amount in TFL's Bank Account</p>		
D. SUBMISSION AND OPENING OF BIDS			
ITB clause	Description		
18	In addition to the original of the Bid, the number of copies required is one. Not applicable in case of e-tendering.		
4.0 of IFB	<p>The submission of physical document as per clause no. 4.0 of IFB shall at following address:</p> <p>M/s Projects & Development India Limited, P.D.I.L Bhawan, A-14, Sector-1, Noida, (PIN 201301) Dist. Gautam Budh Nagar (UP). (India)</p> <p>Kind Attention: Ms Anjali Thakur, Dy. General Manager (M.M) Fax no. : +91-120-2529801 Tel no. : +91-120-2544063</p>		
E. EVALUATION, AND COMPARISON OF BIDS			
ITB clause	Description		
32	Evaluation Methodology is mentioned in Section-II of tender.		

33	Compensation for Extended Stay: APPLICABLE	<input checked="" type="checkbox"/>
	NOT APPLICABLE	<input checked="" type="checkbox"/>
F. AWARD OF CONTRACT		
ITB clause	Description	
37	State of India of which stamp paper is required for Contract Agreement: Odisha State where Bidder's Registered or Corporate Office is located.	
38	Contract Performance Security/ Security Deposit	
	APPLICABLE	<input checked="" type="checkbox"/>
	NOT APPLICABLE	<input checked="" type="checkbox"/>
	<p><u>The value/ amount of Contract Performance Security/ Security Deposit:</u></p> <p>SD/ CPS @10% of Total order/ contract value within 30 days of FOA/ notification of award.</p> <p>Or,</p> <p>Initial Security Deposited (ISD) @ 5% of Total Contract value within 30 days of FOA/ notification of Award and deduction @ 10% of the RA Bill subsequently from RA bills till the total amount of security deposite (including ISD and deducted amount) reaches 10% of total contract value.)</p>	
41	Provision of AHR Item :	
	APPLICABLE	<input checked="" type="checkbox"/>
	NOT APPLICABLE	<input checked="" type="checkbox"/>
44.1	Quarterly Closure of Contract:	
	APPLICABLE	<input checked="" type="checkbox"/>
	NOT APPLICABLE	<input checked="" type="checkbox"/>
49	Applicability of BEC relaxation relating to Startups:	
	APPLICABLE	<input checked="" type="checkbox"/>
	NOT APPLICABLE	<input checked="" type="checkbox"/>

**PUBLIC PROCUREMENT
(PREFERENCE TO MAKE IN INDIA), ORDER 2017**

No. P-45021/2/2017-PP (BE-II)
Government of India
Ministry of Commerce and Industry
Department for Promotion of Industry and Internal Trade
(Public Procurement Section)

Udyog Bhawan, New Delhi
Dated: 16th September, 2020

To

All Central Ministries/Departments/CPSUs/All concerned

ORDER

Subject: Public Procurement (Preference to Make in India), Order 2017– Revision; regarding.

Department for Promotion of Industry and Internal Trade, in partial modification [Paras 2, 3, 5, 10 & 13] of Order No.P-45021/2/2017-B.E.-II dated 15.6.2017 as amended by Order No.P-45021/2/2017-B.E.-II dated 28.05.2018, Order No.P-45021/2/2017-B.E.-II dated 29.05.2019 and Order No.P-45021/2/2017-B.E.-II dated 04.06.2020, hereby issues the revised 'Public Procurement (Preference to Make in India), Order 2017' dated 16.09.2020 effective with immediate effect.

Whereas it is the policy of the Government of India to encourage 'Make in India' and promote manufacturing and production of goods and services in India with a view to enhancing income and employment, and

Whereas procurement by the Government is substantial in amount and can contribute towards this policy objective, and

Whereas local content can be increased through partnerships, cooperation with local companies, establishing production units in India or Joint Ventures (JV) with Indian suppliers, increasing the participation of local employees in services and training them,

Now therefore the following Order is issued:

1. This Order is issued pursuant to Rule 153 (iii) of the General Financial Rules 2017.
2. **Definitions:** For the purposes of this Order:

'Local content' means the amount of value added in India which shall, unless otherwise prescribed by the Nodal Ministry, be the total value of the item procured (excluding net domestic indirect taxes) minus the value of imported content in the item (including all customs duties) as a proportion of the total value, in percent.

'Class-I local supplier' means a supplier or service provider, whose goods, services or works offered for procurement, meets the minimum local content as prescribed for 'Class-I local supplier' under this Order.

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'Class-II local supplier' means a supplier or service provider, whose goods, services or works offered for procurement, meets the minimum local content as prescribed for 'Class-II local supplier' but less than that prescribed for 'Class-I local supplier' under this Order.

'Non - Local supplier' means a supplier or service provider, whose goods, services or works offered for procurement, has local content less than that prescribed for 'Class-II local supplier' under this Order.

'L1' means the lowest tender or lowest bid or the lowest quotation received in a tender, bidding process or other procurement solicitation as adjudged in the evaluation process as per the tender or other procurement solicitation.

'Margin of purchase preference' means the maximum extent to which the price quoted by a "Class-I local supplier" may be above the L1 for the purpose of purchase preference.

'Nodal Ministry' means the Ministry or Department identified pursuant to this order in respect of a particular item of goods or services or works.

'Procuring entity' means a Ministry or department or attached or subordinate office of, or autonomous body controlled by, the Government of India and includes Government companies as defined in the Companies Act.

'Works' means all works as per Rule 130 of GFR- 2017, and will also include 'turnkey works'.

3. Eligibility of 'Class-I local supplier'/ 'Class-II local supplier'/ 'Non-local suppliers' for different types of procurement

(a) In procurement of all goods, services or works in respect of which the Nodal Ministry / Department has communicated that there is sufficient local capacity and local competition, only 'Class-I local supplier', as defined under the Order, shall be eligible to bid irrespective of purchase value.

(b) Only 'Class-I local supplier' and 'Class-II local supplier', as defined under the Order, shall be eligible to bid in procurements undertaken by procuring entities, except when Global tender enquiry has been issued. In global tender enquiries, 'Non-local suppliers' shall also be eligible to bid along with 'Class-I local suppliers' and 'Class-II local suppliers'. In procurement of all goods, services or works, not covered by sub-para 3(a) above, and with estimated value of purchases less than Rs. 200 Crore, in accordance with Rule 161(iv) of GFR, 2017, Global tender enquiry shall not be issued except with the approval of competent authority as designated by Department of Expenditure.

(c) For the purpose of this Order, works includes Engineering, Procurement and Construction (EPC) contracts and services include System Integrator (SI) contracts.

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3A. Purchase Preference

(a) Subject to the provisions of this Order and to any specific instructions issued by the Nodal Ministry or in pursuance of this Order, purchase preference shall be given to 'Class-I local supplier' in procurements undertaken by procuring entities in the manner specified here under.

(b) In the procurements of goods or works, which are covered by para 3(b) above and which are divisible in nature, the 'Class-I local supplier' shall get purchase preference over 'Class-II local supplier' as well as 'Non-local supplier', as per following procedure:

- i. Among all qualified bids, the lowest bid will be termed as L1. If L1 is 'Class-I local supplier', the contract for full quantity will be awarded to L1.
- ii. If L1 bid is not a 'Class-I local supplier', 50% of the order quantity shall be awarded to L1. Thereafter, the lowest bidder among the 'Class-I local supplier' will be invited to match the L1 price for the remaining 50% quantity subject to the Class-I local supplier's quoted price falling within the margin of purchase preference, and contract for that quantity shall be awarded to such 'Class-I local supplier' subject to matching the L1 price. In case such lowest eligible 'Class-I local supplier' fails to match the L1 price or accepts less than the offered quantity, the next higher 'Class-I local supplier' within the margin of purchase preference shall be invited to match the L1 price for remaining quantity and so on, and contract shall be awarded accordingly. In case some quantity is still left uncovered on Class-I local suppliers, then such balance quantity may also be ordered on the L1 bidder.

(c) In the procurements of goods or works, which are covered by para 3(b) above and which are not divisible in nature, and in procurement of services where the bid is evaluated on price alone, the 'Class-I local supplier' shall get purchase preference over 'Class-II local supplier' as well as 'Non-local supplier', as per following procedure:

- i. Among all qualified bids, the lowest bid will be termed as L1. If L1 is 'Class-I local supplier', the contract will be awarded to L1.
- ii. If L1 is not 'Class-I local supplier', the lowest bidder among the 'Class-I local supplier', will be invited to match the L1 price subject to Class-I local supplier's quoted price falling within the margin of purchase preference, and the contract shall be awarded to such 'Class-I local supplier' subject to matching the L1 price.
- iii. In case such lowest eligible 'Class-I local supplier' fails to match the L1 price, the 'Class-I local supplier' with the next higher bid within the margin of purchase preference shall be invited to match the L1 price and so on and contract shall be awarded accordingly. In case none of the 'Class-I local supplier' within the margin of purchase preference matches the L1 price, the contract may be awarded to the L1 bidder.

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(d) "Class-II local supplier" will not get purchase preference in any procurement, undertaken by procuring entities.

3B. Applicability in tenders where contract is to be awarded to multiple bidders - In tenders where contract is awarded to multiple bidders subject to matching of L1 rates or otherwise, the 'Class-I local supplier' shall get purchase preference over 'Class-II local supplier' as well as 'Non-local supplier', as per following procedure:

a) In case there is sufficient local capacity and competition for the item to be procured, as notified by the nodal Ministry, only Class I local suppliers shall be eligible to bid. As such, the multiple suppliers, who would be awarded the contract, should be all and only 'Class I Local suppliers'.

b) In other cases, 'Class II local suppliers' and 'Non local suppliers' may also participate in the bidding process along with 'Class I Local suppliers' as per provisions of this Order.

c) If 'Class I Local suppliers' qualify for award of contract for at least 50% of the tendered quantity in any tender, the contract may be awarded to all the qualified bidders as per award criteria stipulated in the bid documents. However, in case 'Class I Local suppliers' do not qualify for award of contract for at least 50% of the tendered quantity, purchase preference should be given to the 'Class I local supplier' over 'Class II local suppliers' / 'Non local suppliers' provided that their quoted rate falls within 20% margin of purchase preference of the highest quoted bidder considered for award of contract so as to ensure that the 'Class I Local suppliers' taken in totality are considered for award of contract for at least 50% of the tendered quantity.

d) First purchase preference has to be given to the lowest quoting 'Class-I local supplier', whose quoted rates fall within 20% margin of purchase preference, subject to its meeting the prescribed criteria for award of contract as also the constraint of maximum quantity that can be sourced from any single supplier. If the lowest quoting 'Class-I local supplier', does not qualify for purchase preference because of aforesaid constraints or does not accept the offered quantity, an opportunity may be given to next higher 'Class-I local supplier', falling within 20% margin of purchase preference, and so on.

e) To avoid any ambiguity during bid evaluation process, the procuring entities may stipulate its own tender specific criteria for award of contract amongst different bidders including the procedure for purchase preference to 'Class-I local supplier' within the broad policy guidelines stipulated in sub-paras above.

4. Exemption of small purchases: Notwithstanding anything contained in paragraph 3, procurements where the estimated value to be procured is less than Rs. 5 lakhs shall be exempt from this Order. However, it shall be ensured by procuring entities that procurement is not split for the purpose of avoiding the provisions of this Order.

5. Minimum local content: The 'local content' requirement to categorize a supplier as 'Class-I local supplier' is minimum 50%. For 'Class-II local supplier', the 'local content' requirement is minimum 20%. Nodal Ministry/ Department may prescribe only a higher

.....Contd. p/5

percentage of minimum local content requirement to categorize a supplier as 'Class-I local supplier'/ 'Class-II local supplier'. For the items, for which Nodal Ministry/ Department has not prescribed higher minimum local content notification under the Order, it shall be 50% and 20% for 'Class-I local supplier'/ 'Class-II local supplier' respectively.

6. **Margin of Purchase Preference:** The margin of purchase preference shall be 20%.
7. **Requirement for specification in advance:** The minimum local content, the margin of purchase preference and the procedure for preference to Make in India shall be specified in the notice inviting tenders or other form of procurement solicitation and shall not be varied during a particular procurement transaction.
8. **Government E-marketplace:** In respect of procurement through the Government E-marketplace (GeM) shall, as far as possible, specifically mark the items which meet the minimum local content while registering the item for display, and shall, wherever feasible, make provision for automated comparison with purchase preference and without purchase preference and for obtaining consent of the local supplier in those cases where purchase preference is to be exercised.
9. **Verification of local content:**
 - a. The 'Class-I local supplier'/ 'Class-II local supplier' at the time of tender, bidding or solicitation shall be required to indicate percentage of local content and provide self-certification that the item offered meets the local content requirement for 'Class-I local supplier'/ 'Class-II local supplier', as the case may be. They shall also give details of the location(s) at which the local value addition is made.
 - b. In cases of procurement for a value in excess of Rs. 10 crores, the 'Class-I local supplier'/ 'Class-II local supplier' shall be required to provide a certificate from the statutory auditor or cost auditor of the company (in the case of companies) or from a practicing cost accountant or practicing chartered accountant (in respect of suppliers other than companies) giving the percentage of local content.
 - c. Decisions on complaints relating to implementation of this Order shall be taken by the competent authority which is empowered to look into procurement-related complaints relating to the procuring entity.
 - d. Nodal Ministries may constitute committees with internal and external experts for independent verification of self-declarations and auditor's/ accountant's certificates on random basis and in the case of complaints.
 - e. Nodal Ministries and procuring entities may prescribe fees for such complaints.
 - f. False declarations will be in breach of the Code of Integrity under Rule 175(1)(i)(h) of the General Financial Rules for which a bidder or its successors can be debarred for up to two years as per Rule 151 (iii) of the General Financial Rules along with such other actions as may be permissible under law.

- g. A supplier who has been debarred by any procuring entity for violation of this Order shall not be eligible for preference under this Order for procurement by any other procuring entity for the duration of the debarment. The debarment for such other procuring entities shall take effect prospectively from the date on which it comes to the notice of other procurement entities, in the manner prescribed under paragraph 9h below.
- h. The Department of Expenditure shall issue suitable instructions for the effective and smooth operation of this process, so that:
 - i. The fact and duration of debarment for violation of this Order by any procuring entity are promptly brought to the notice of the Member-Convenor of the Standing Committee and the Department of Expenditure through the concerned Ministry /Department or in some other manner;
 - ii. on a periodical basis such cases are consolidated and a centralized list or decentralized lists of such suppliers with the period of debarment is maintained and displayed on website(s);
 - iii. in respect of procuring entities other than the one which has carried out the debarment, the debarment takes effect prospectively from the date of uploading on the website(s) in the such a manner that ongoing procurements are not disrupted.

10. Specifications in Tenders and other procurement solicitations:

- a. Every procuring entity shall ensure that the eligibility conditions in respect of previous experience fixed in any tender or solicitation do not require proof of supply in other countries or proof of exports.
- b. Procuring entities shall endeavour to see that eligibility conditions, including on matters like turnover, production capability and financial strength do not result in unreasonable exclusion of 'Class-I local supplier'/ 'Class-II local supplier' who would otherwise be eligible, beyond what is essential for ensuring quality or creditworthiness of the supplier.
- c. Procuring entities shall, within 2 months of the issue of this Order review all existing eligibility norms and conditions with reference to sub-paragraphs 'a' and 'b' above.

d. Reciprocity Clause

- i. When a Nodal Ministry/Department identifies that Indian suppliers of an item are not allowed to participate and/ or compete in procurement by any foreign government, due to restrictive tender conditions which have direct or indirect effect of barring Indian companies such as registration in the procuring country, execution of projects of specific value in the procuring country etc., it shall provide such details to all its procuring entities including CMDs/CEOs of PSEs/PSUs, State Governments and other procurement agencies under their administrative control and GeM for appropriate reciprocal action.

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- ii. Entities of countries which have been identified by the nodal Ministry/Department as not allowing Indian companies to participate in their Government procurement for any item related to that nodal Ministry shall not be allowed to participate in Government procurement in India for all items related to that nodal Ministry/ Department, except for the list of items published by the Ministry/ Department permitting their participation.
 - iii. The stipulation in (ii) above shall be part of all tenders invited by the Central Government procuring entities stated in (i) above. All purchases on GeM shall also necessarily have the above provisions for items identified by nodal Ministry/ Department.
 - iv. State Governments should be encouraged to incorporate similar provisions in their respective tenders.
 - v. The term 'entity' of a country shall have the same meaning as under the FDI Policy of DPIIT as amended from time to time.
- e. Specifying foreign certifications/ unreasonable technical specifications/ brands/ models in the bid document is restrictive and discriminatory practice against local suppliers. If foreign certification is required to be stipulated because of non-availability of Indian Standards and/or for any other reason, the same shall be done only after written approval of Secretary of the Department concerned or any other Authority having been designated such power by the Secretary of the Department concerned.
- f. "All administrative Ministries/Departments whose procurement exceeds Rs. 1000 Crore per annum shall notify/ update their procurement projections every year, including those of the PSEs/PSUs, for the next 5 years on their respective website."

10A. Action for non-compliance of the Provisions of the Order: In case restrictive or discriminatory conditions against domestic suppliers are included in bid documents, an inquiry shall be conducted by the Administrative Department undertaking the procurement (including procurement by any entity under its administrative control) to fix responsibility for the same. Thereafter, appropriate action, administrative or otherwise, shall be taken against erring officials of procurement entities under relevant provisions. Intimation on all such actions shall be sent to the Standing Committee.

11. Assessment of supply base by Nodal Ministries: The Nodal Ministry shall keep in view the domestic manufacturing / supply base and assess the available capacity and the extent of local competition while identifying items and prescribing the higher minimum local content or the manner of its calculation, with a view to avoiding cost increase from the operation of this Order.

12. Increase in minimum local content: The Nodal Ministry may annually review the local content requirements with a view to increasing them, subject to availability of sufficient local competition with adequate quality.

13. Manufacture under license/ technology collaboration agreements with phased indigenization: While notifying the minimum local content, Nodal Ministries may make special provisions for exempting suppliers from meeting the stipulated local content if the product is being manufactured in India under a license from a foreign manufacturer who holds intellectual property rights and where there is a technology collaboration agreement / transfer of technology agreement for indigenous manufacture of a product developed abroad with clear phasing of increase in local content.

13A. In procurement of all goods, services or works in respect of which there is substantial quantity of public procurement and for which the nodal ministry has not notified that there is sufficient local capacity and local competition, the concerned nodal ministry shall notify an upper threshold value of procurement beyond which foreign companies shall enter into a joint venture with an Indian company to participate in the tender. Procuring entities, while procuring such items beyond the notified threshold value, shall prescribe in their respective tenders that foreign companies may enter into a joint venture with an Indian company to participate in the tender. The procuring Ministries/Departments shall also make special provisions for exempting such joint ventures from meeting the stipulated minimum local content requirement, which shall be increased in a phased manner.

14. Powers to grant exemption and to reduce minimum local content: The administrative Department undertaking the procurement (including procurement by any entity under its administrative control), with the approval of their Minister-in-charge, may by written order, for reasons to be recorded in writing,

- a. reduce the minimum local content below the prescribed level; or
- b. reduce the margin of purchase preference below 20%; or
- c. exempt any particular item or supplying entities from the operation of this Order or any part of the Order.

A copy of every such order shall be provided to the Standing Committee and concerned Nodal Ministry / Department. The Nodal Ministry / Department concerned will continue to have the power to vary its notification on Minimum Local Content.

15. Directions to Government companies: In respect of Government companies and other procuring entities not governed by the General Financial Rules, the administrative Ministry or Department shall issue policy directions requiring compliance with this Order.

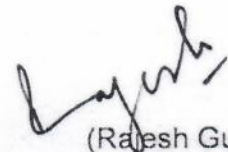
16. Standing Committee: A standing committee is hereby constituted with the following membership:

- Secretary, Department for Promotion of Industry and Internal Trade—Chairman
- Secretary, Commerce—Member
- Secretary, Ministry of Electronics and Information Technology—Member
- Joint Secretary (Public Procurement), Department of Expenditure—Member
- Joint Secretary (DPIIT)—Member-Convenor

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The Secretary of the Department concerned with a particular item shall be a member in respect of issues relating to such item. The Chairman of the Committee may co-opt technical experts as relevant to any issue or class of issues under its consideration.

17. **Functions of the Standing Committee:** The Standing Committee shall meet as often as necessary, but not less than once in six months. The Committee
- a. shall oversee the implementation of this order and issues arising therefrom, and make recommendations to Nodal Ministries and procuring entities.
 - b. shall annually assess and periodically monitor compliance with this Order
 - c. shall identify Nodal Ministries and the allocation of items among them for issue of notifications on minimum local content
 - d. may require furnishing of details or returns regarding compliance with this Order and related matters
 - e. may, during the annual review or otherwise, assess issues, if any, where it is felt that the manner of implementation of the order results in any restrictive practices, cartelization or increase in public expenditure and suggest remedial measures
 - f. may examine cases covered by paragraph 13 above relating to manufacture under license/ technology transfer agreements with a view to satisfying itself that adequate mechanisms exist for enforcement of such agreements and for attaining the underlying objective of progressive indigenization
 - g. may consider any other issue relating to this Order which may arise.
18. **Removal of difficulties:** Ministries /Departments and the Boards of Directors of Government companies may issue such clarifications and instructions as may be necessary for the removal of any difficulties arising in the implementation of this Order.
19. **Ministries having existing policies:** Where any Ministry or Department has its own policy for preference to local content approved by the Cabinet after 1st January 2015, such policies will prevail over the provisions of this Order. All other existing orders on preference to local content shall be reviewed by the Nodal Ministries and revised as needed to conform to this Order, within two months of the issue of this Order.
20. **Transitional provision:** This Order shall not apply to any tender or procurement for which notice inviting tender or other form of procurement solicitation has been issued before the issue of this Order.



(Rajesh Gupta)
Director

Tel: 23063211

rajesh.gupta66@gov.in

FORM – I of ANNEXURE V

CERTIFICATE FROM STATUTORY AUDITOR OR COST AUDITOR OF THE COMPANY (IN THE CASE OF COMPANIES) OR FROM A PRACTICING COST ACCOUNTANT OR PRACTICING CHARTERED ACCOUNTANT (IN RESPECT OF SUPPLIERS OTHER THAN COMPANIES) TOWARDS MINIMUM LOCAL CONTENT

(FOR SUPPLY OF GOODS/ SERVICES / WORKS / EPC / LSTK)

To,
M/s Talcher Fertilizers Limited

SUB:

TENDER NO:

Dear Sir

- A. We..... the Statutory Auditor / Cost Auditor / Practicing Cost Accountant / Practicing Chartered Accountant) have verified relevant records of M/s **(Name of the bidder)** and certify that M/s **(Name of the bidder)** meets the following:

Sl. No.	Description	Confirmation
a	Bidder meets the mandatory minimum Local content requirement of 20% for participating in the Bidding process under Public Procurement (Preference to Make in India) Policy. (In case bidder does not meet the minimum Local content requirement of 20%, such bidders are not allowed to participate in the Bidding process)	Confirmed.
b	The bidder meets mandatory minimum Local content requirement of 50% for claiming purchase preference under Public Procurement (Preference to Make in India) Policy	Confirmed / Not Confirmed

- B. The **details of the location** at which the local value addition is made as follows:

Sl. No.	Item Description	Details of the Location(s) where the local value addition is made
1.		
2.		
3.		

Name of Audit Firm / Chartered Accountant: [Signature of Authorized Signatory]

Name:

Date:

Designation:

Seal:

Membership No.:

UDIN:

FORM-II of ANNEXURE-V

Salient Points of Public Procurement (Preference to Make in India) Policy

Sr. No.	Description	Parameter / Document
1	Minimum Local Content (LC) for Availing Preference under this Policy	50%
2	Margin of Purchase Preference	20%
3	Local Content (LC) % declared by bidder (Documents to be submitted as per Sr. No. 4 below)	[Tick (✓) whichever is applicable] a) LC Equal to or more than 50% <input type="checkbox"/> b) LC More than 20% but less than 50% <input type="checkbox"/>
4	Documents to be submitted by bidder under this Policy	Certificate from the statutory auditor or cost auditor of the company (in case of companies) or from a practicing cost accountant or practicing chartered accountant as per <u>Form-I</u> to be submitted by bidder.
5	Whether tender is divisible or not divisible	Not Divisible; Clause No. 3A (c) of revised Policy dated 16.09.2020 shall be applicable

PREAMBLE TO SCHEDULE OF RATES

1. The “Schedule of Rates (SOR)” will be in Excel format (password protected) and will be uploaded during tender creation. This will be downloaded by the bidder and bidder will quote price on this Excel file for entire scope of work as per NIT. Thereafter, the bidder will upload the same Excel file during bid submission.
2. The SOR format is provided in a spread sheet file (BoQ_xxxx.xls). The rates offered should be entered in the allotted space only and uploaded after filling the relevant columns. The SOR template must not be modified / replaced by the bidder; else the bid submitted shall be rejected.
3. Bidder shall quote for all the items in INR only.
4. Quantities mentioned in the Schedule of Rates are indicative and not exhaustive in nature. Payment shall be made as per actual quantity used/certified at site by Owner’s Engineer-in-charge. Quantities indicated in Schedule of Rates are approximate and subject to variation on either side. The quantity of individual item may be deleted. Contractor shall not be entitled for any compensation on this account and the quoted rates shall hold good for such quantity variations etc. Payments on bills shall, however, be made on actual measurements of quantities of work done as per approved drawings.
5. Goods & Services Tax (GST) is applicable @ 18% on the quoted rates (being Works Contract)
6. It is mandatory to quote prices in SOR. It will be the responsibility of the contractor to quote for all items as per scope of work and terms and conditions defined in NIT.
7. A copy of SOR, with prices/figures completely blanked out but with the word “QUOTED” in all columns is to be uploaded along with the unpriced bid, as a confirmation of price/data quoted against each head.

**CLAUSE REGARDING PROVISION FOR PROCUREMENT FROM A BIDDER WHICH SHARES A
LAND BORDER WITH INDIA**

1. OM no. 7/10/2021-PPD(1) dated 23.02.2023, Department of Expenditure, Ministry of Finance, Govt. of India refers. The same are available at website <https://doe.gov.in/procurement-policy-divisions>.
2. Any bidder from a country which shares a land border with India will be eligible to bid in this tender only if the bidder is registered with the Competent Authority. For details of competent authority refer to Annexure I of Order (Public Procurement no. 4) dated 23.02.2023.

Further, any bidder (including bidder from India) having specified Transfer of Technology (ToT) arrangement with an entity from a country which shares a land border with India, shall also require to be registered with the same competent authority.

Further the above will not apply to bidders from those countries (even if sharing a land border with India) to which the Government of India has extended lines of credit or in which the Government of India is engaged in development projects. Updated lists of countries to which lines of credit have been extended or in which development projects are undertaken are given in the website of the Ministry of External Affairs, Govt. of India

3. **"Bidder"** (including the term 'tenderer', 'consultant' 'vendor' or 'service provider' in certain contexts) **for purpose of this provision** means any person or firm or company, including any member of a consortium or joint venture (that is an association of several persons, or firms or companies), every artificial juridical person not falling in any of the descriptions of bidders stated hereinbefore, including any agency, branch or office controlled by such person, participating in a procurement process.
4. **"Bidder from a country which shares a land border with India"** for the purpose of this:
 - a. An entity incorporated, established or registered in such a country; or
 - b. A subsidiary of an entity incorporated, established or registered in such a country; or
 - c. An entity substantially controlled through entities incorporated, established or registered in such a country; or
 - d. An entity whose beneficial owner is situated in such a country; or
 - e. An Indian (or other) agent of such an entity; or
 - f. A natural person who is a citizen of such a country; or
 - g. A consortium or joint venture where any member of the consortium or joint venture falls under any of the above
5. **"Beneficial owner"** for the purpose of above (4) will be as under:

- i. In case of a company or Limited Liability Partnership, the beneficial owner is the natural person(s), who, whether acting alone or together, or through one or more juridical person(s), has a controlling ownership interest or who exercises control through other means.

Explanation—

- a) "Controlling ownership interest" means ownership of, or entitlement to, more than twenty-five per cent of shares or capital or profits of the company;
- b) "Control" shall include the right to appoint the majority of the directors or to control the management or policy decisions, including by virtue of their shareholding or management rights or shareholders agreements or voting agreements;
- ii) In case of a partnership firm, the beneficial owner is the natural person(s) who, whether acting alone or together, or through one or more juridical person, has ownership of entitlement to more than fifteen percent of capital or profits of the partnership;
- iii) In case of an unincorporated association or body of individuals, the beneficial owner is the natural person(s), who, whether acting alone or together, or through one or more juridical person, has ownership of or entitlement to more than fifteen percent of the property or capital or profits of such association or body of individuals;
- iv) Where no natural person is identified under (i) or (ii) or (iii) above, the beneficial owner is the relevant natural person who holds the position of senior managing official;
- v) In case of a trust, the identification of beneficial owner(s) shall include identification of the author of the trust, the trustee, the beneficiaries with fifteen percent or more interest in the trust and any other natural person exercising ultimate effective control over the trust through a chain of control or ownership.

6. "**Agent**" for the purpose of this Order is a person employed to do any act for another, or to represent another in dealings with third persons

Note :

- (i) A person who procures and supplies finished goods from an entity from a country which shares a land border with India will, regardless of the nature of his legal or commercial relationship with the producer of the goods, be deemed to be an Agent for the purpose of this Order.
- (ii) However, a bidder who only procures raw material, components etc. from an entity from a country which shares a land border with India and then manufactures or converts them into other goods will not be treated as an Agent.]

7. **"Transfer of Technology"** means dissemination and transfer of all forms of commercially usable knowledge such as transfer of know-how, skills, technical expertise, designs, processes and procedures, trade secrets, which enables the acquirer of such technology to perform activities using the transferred technology independently. (Matters of interpretation of this term shall be referred to the Registration Committee constituted by the Department for Promotion of Industry and Internal Trade, and the interpretation of the Committee shall be final.)

8. **"Specified Transfer of Technology"** means a transfer of technology in the sectors and/ or technologies, specified at Schedule-I, II & 3 of this order.

9. **SUBMISSION OF CERTIFICATE IN BIDS:**

Bidder shall submit a certificate in this regard as Form-I.

For cases falling under the category of Transfer of Technology, Bidder shall submit a certificate in this regard as Form-II.

If such certificate given by a bidder whose bid is accepted is found to be false, this would be a ground for immediate rejection of the bid/termination and further action as per "Procedure for Action in case of Corrupt/Fraudulent/ Collusive / Coercive Practices" of tender document.

10. The registration, wherever applicable, should be valid at the time of submission of bids and at the time of acceptance of bids. In respect of supply otherwise than by tender, registration should be valid at the time of placement of order. If the bidder was validly registered at the time of acceptance / placement of order, registration shall not be a relevant consideration during contract execution.

11. **PROVISION TO BE IN WORKS CONTRACTS, INCLUDING TURNKEY CONTRACTS:**

The successful bidder shall not be allowed to sub-contract works to any contractor from a country which shares a land border with India unless such contractor is registered with the Competent Authority. The definition of "contractor from a country which shares a land border with India" shall be as in Para 4 herein above. A Certificate to this regard is to be submitted by bidder is placed at Form-I.

[Note: Procurement of raw material, components, etc. does not constitute sub-contracting]

UNDERTAKING ON LETTERHEAD

To,
M/s Talcher Fertilizers Limited

SUB:

TENDER NO:

Dear Sir

We have read the clause regarding Provisions for Procurement from a Bidder of a country which shares a land border with India and on sub-contracting to contractors from such countries; we certify that, bidder M/s _____ (**Name of Bidder**) is:

- (i) not from such a country []]
- (ii) if from such a country, has been registered with the Competent Authority. []]
(Evidence of valid registration by the Competent Authority shall be attached)

(Bidder is to tick appropriate option (✓ or X) above).

We further certify that bidder **M/s** _____ (**Name of Bidder**) will not sub-contract any work to a contractor from such countries unless such contractor is registered with the Competent Authority.

We hereby certify that bidder **M/s** _____ (**Name of Bidder**) fulfills all requirements in this regard and is eligible to be considered.

Place: [Signature of Authorized Signatory of Bidder]
Date: Name:
Designation:
Seal:

UNDERTAKING ON LETTERHEAD

(Applicable in case of Transfer of Technology cases only)

To,

M/s TALCHER FERTILIZERS LIMITED

SUB:

TENDER NO:

Dear Sir

We have read the clause regarding Provisions for Procurement from a Bidder having Transfer of Technology (ToT) arrangement which shares a land border with India, we certify that, bidder M/s _____ (***Name of Bidder***) is :

- (i) Does not have ToT with such a country []
- (ii) If having ToT from such a country, has been registered with the Competent Authority. []

(Evidence of valid registration by the Competent Authority shall be attached)

(Bidder is to tick appropriate option (✓) above).

We hereby certify that bidder M/s _____ (***Name of Bidder***) fulfills all requirements in this regard and is eligible to be considered against the tender.

Place: [Signature of Authorized Signatory of Bidder]

Date: Name:

Designation:

Seal:

Schedule I

List of Category-I Sensitive sectors:

Sr. No.	Sector
(i)	Atomic Energy
(ii)	Brocasting/ Print and Digital Media
(iii)	Defense
(iv)	Space
(v)	Telecommunications

Schedule II

List of Category-II Sensitive sectors:

Sr.No.	Sector
(i)	Power and Energy (including exploration/ generation/transmission/ distribution/ pipeline)
(ii)	Banking and Finance including Insurance
(iii)	Civil Aviation
(iv)	Construction of ports and dams & river valley projects
(v)	Electronics and Microelectronics
(vi)	Meteorology and Ocean Observation
(vii)	Mining and extraction (including deep sea projects)

(viii)	Railways
(ix)	Pharmaceuticals & Medical Devices
(x)	Agriculture
(xi)	Health
(xii)	Urban Transportation

Schedule III

List of Sensitive Technologies:

Sr.No.	Sensitive Technologies
(i)	Additive Manufacturing (e.g. 3D Printing)
(ii)	Any equipment having electronic programmable components or autonomous systems (e.g. SCADA systems)
(iii)	Any technology used for uploading and streaming of data including broadcasting, satellite communication etc.
(iv)	Chemical Technologies
(v)	Biotechnologies including Genetic Engineering and Biological Technologies
(vi)	Information and Communication Technologies
(vii)	Software

FORMS & FORMATS

LIST OF FORMS & FORMATS

Form No.	Description
F-1	BIDDER'S GENERAL INFORMATION
F-2A	PROFORMA OF "BANK GUARANTEE"FOR "EARNEST MONEY / BID SECURITY"
F-2B	FORMAT OF " DECLARATION FOR BID SECURITY "
F-3	LETTER OF AUTHORITY
F-4	PROFORMA OF "BANK GUARANTEE" FOR "CONTRACT PERFORMANCE SECURITY / SECURITY DEPOSIT"
F-4(a)	MATTER TO BE MENTIONED IN COVERING LETTER TO BE SUBMITTED BY VENDOR ALONG WITH BANK GUARANTEE (BG)
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F-6	ACKNOWLEDGEMENT CUM CONSENT LETTER
F-7	BIDDER'S EXPERIENCE
F-8(A)	CHECKLIST
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F-9	FORMAT FOR CERTIFICATE FROM BANKIF BIDDER'S WORKING CAPITAL IS INADEQUATE
F-10	FORMAT FOR CHARTERED ACCOUNTANT CERTIFICATE FOR FINANCIAL CAPABILITY OF THE BIDDER
F-11	FORMAT FOR CONSORTIUM AGREEMENT
F-12	BIDDER'S QUERIES FOR PRE BID MEETING
F-13	E-BANKING FORMAT
F-14	INTEGRITY PACT
F-15	INDEMNITY BOND
F-16	FREQUENTLY ASKED QUESTIONS (FAQS)
F-17	PROFORMA OF BANK GUARANTEE FOR MOBILISATIONS ADVANCE PAYMENT
F-17 (a)	MATTER TO BE MENTIONED IN COVERING LETTER TO BE SUBMITTED BY VENDOR ALONG WITH BANK GUARANTEE (BG)
F-18	PROFORMA OF BANK GUARANTEE FOR PAYMENTS TOWARDS PLACEMENT OF ALL PURCHASE ORDERS OF MAJOR TAGGED ITEMS
F-19	FORMAT OF LETTER OF NO DEVIATIONS
F-20	FORMAT FOR POWER OF ATTORNEY
F-21	UNDERTAKING REGARDING SUBMISSION OF ELECTRONIC INVOICE(E-INVOICE AS PER GST LAW)
F-22	UNDERTAKING REGARDING SUBMISSION CONTRACT PERFORMANCE SECURITY (CPS) / SECURITY DEPOSIT (SD) WITHIN STIPULATED TIME LINE

F-23	PROFORMA FOR CONTRACT AGREEMENT
F-24	NO CLAIM CERTIFICATE

F-1

BIDDER'S GENERAL INFORMATION

To,
M/s Talcher Fertilizers Limited

TENDER NO:

1	Bidder Name:	M/s.....
2	Status of Firm	Proprietorship Firm/Partnership firm/ Public Limited/ Pvt. Limited/ Govt. Dept. / PSU/ Others If Others Specify: _____ [Enclose relevant certificates / partnership deed/certificate of Registration, as applicable]
3	Name of Proprietor/ Partners/ Directors of the firm/company	1. 2. 3.
4	Name of Power of Attorney holders of bidder	
5	Number of Years in Operation	
6	Address of Registered Office	_____ City: _____ District: _____ State: _____ PIN/ZIP : _____
7	Bidder's address where order/contract is to be placed	_____ City: _____ District: _____ State: _____ PIN/ZIP : _____
8	Office responsible for executing the contract with GST no.(In case supply of works are from multiple locations, addresses and GST no. of all such locations are to be provided)	City: District: State: PIN/ZIP: GST No.:
9	Telephone Number & Contact Information of address where order is to be placed	_____ (Country Code) (Area Code) (Telephone Number) FAX No. : e-mail ID:
10	E-mail Address	

11	ISO Certification, if any {If yes, please furnish details}	
12	PAN No	[Enclose copy of relevant document]
13	GST No. (refer sl. no. 8 above)	[Enclose copy of relevant document]
14	EPF Registration No.	[Enclose copy of relevant document]
15	ESI code No.	[Enclose copy of relevant document]
16	Whether Micro or Small Enterprise	Yes / No (If Yes, Bidder to submit requisite documents as specified in ITB: Clause No. 40)
	Whether MSE is owned by SC/ST Entrepreneur(s)	Yes / No (If Yes, Bidder to submit requisite documents as specified in ITB: Clause No. 40)
	Whether MSE is owned by Women	Yes / No (If Yes, Bidder to submit requisite documents as specified in ITB: Clause No. 40)
17	Whether Bidder is Startups or not	Yes / No (If Yes, Bidder to submit requisite documents as specified in ITB: Clause No. 49)
18	In case of Start-up confirm the following: (i) Date of its incorporation/ registration (ii) Whether turnover for any financial years since incorporation/ registration has exceeded Rs.100 Crores.	

Note: * TFL intent to place the contract directly on the address from where Works are to be supplied. In case, bidder wants contract at some other address or Works are to be supplied from multiple locations, bidder is required to provide in their bid, the address on which contract is to be placed.

Place:

[Signature of Authorized Signatory of Bidder]

Date:

Name:

Designation:

Seal:

FORMAT F-2A

PROFORMA OF "BANK GUARANTEE"
FOR "EARNEST MONEY / BID SECURITY"

(To be stamped in accordance with the Stamp Act)

To, Talcher Fertilizers Limited (TFL) _____	Bank Guarantee No.	
	Date of BG	
	BG Valid up to (Expiry date)	
	Claim period up to (indicate date of expiry of claim period which includes minimum three months from the expiry date)	
	Stamp Sl. No./e-Stamp Certificate No.	

Dear Sir(s),

In accordance with Letter Inviting Tender under your reference No _____ M/s. _____ having their Registered / Head Office at _____ (hereinafter called the Tenderer), wish to participate in the said tender for _____

As an irrevocable Bank Guarantee against Earnest Money for the amount of _____ is required to be submitted by the Tenderer as a condition precedent for participation in the said tender which amount is liable to be forfeited on the happening of any contingencies mentioned in the Tender Document.

We, the _____ Bank at _____ having our Head Office _____ (Local Address) guarantee and undertake to pay immediately on demand without any recourse to the tenderers by Talcher Fertilizers Limited, the amount _____ without any reservation, protest, demur and recourse. Any such demand made by TFL, shall be conclusive and binding on us irrespective of any dispute or difference raised by the Tenderer.

This guarantee shall be irrevocable and shall remain valid up to _____ [this date should be two (02) months beyond the validity of the bid]. If any further extension of this guarantee is required, the same shall be extended to such required period on receiving instructions from M/s. _____ whose behalf this guarantee is issued.

Notwithstanding anything contained herein:

- a) The Bank's liability under this Guarantee shall not exceed (currency in figures) (currency in words only)
- b) This Guarantee shall remain in force upto _____ (this expiry date of BG should be two months beyond the validity of bid) and any extension(s) thereof; and
- c) The Bank shall be released and discharged from all liability under this Guarantee unless a written claim or demand is issued to the Bank on or before the midnight of(indicate date of expiry of claim period which includes minimum three months from the expiry of this Bank Guarantee) and if extended, the date of expiry of the last extension of this Guarantee. If a claim has been received by us within the said date, all the rights of TFL under this Guarantee shall be valid and shall not cease until we have satisfied that claim.

In witness whereof the Bank, through its authorized officer, has set its hand and stamp on this _____ day
of _____ 20__ at _____.

WITNESS:

(SIGNATURE)
(NAME)

(SIGNATURE)
(NAME)
Designation with Bank Stamp

(OFFICIAL ADDRESS)

Attorney as per
Power of Attorney No. _____
Date: _____

INSTRUCTIONS FOR FURNISHING "BID SECURITY / EARNEST MONEY" BY "BANK GUARANTEE"

1. The Bank Guarantee by Bidders will be given on non-judicial stamp paper as per "Stamp Duty" applicable. The non-judicial stamp paper should be in the name of the issuing Bank.
2. The expiry date should be arrived at in accordance with "ITB: Clause-16.1".
3. The Bank Guarantee by bidders will be given from Bank as specified in "ITB Clause-16.2".
4. A letter from the issuing Bank of the requisite Bank Guarantee confirming that said Bank Guarantee / all future communication relating to the Bank Guarantee shall be forwarded to the Employer at its address as mentioned at "ITB".
5. Bidders must indicate the full postal address of the Bank along with the Bank's E-mail / Fax / Phone from where the Earnest Money Bond has been issued as per proforma provided below.
6. If a Bank Guarantee is issued by a commercial Bank, then a letter to Employer confirming its net worth is more than Rs. 1,000,000,000.00 [Rupees One Hundred Crores] or equivalent along with documentary evidence in the Bank Guarantee itself.

FORMAT F-2B

DECLARATION FOR BID SECURITY
(To be submitted on Letter head of Bidder)

To,

M/s TALCHER FERTILIZERS LIMITED

SUB:

TENDER NO:

Dear Sir,

After examining / reviewing provisions of above referred tender documents (including all corrigendum/ Addenda), we M/s _____ (Name of Bidder) have submitted our offer/ bid no. _____.

We, M/s _____ (Name of Bidder) hereby understand that, according to your conditions, we are submitting this Declaration for Bid Security.

We understand that we will be put on watch list/holiday/ banning list (as per policies of TALCHER FERTILIZERS LIMITED in this regard), if we are in breach of our obligation(s) as per following:

- (a) have withdrawn/modified/amended, impairs or derogates from the tender, my/our Bid during the period of bid validity specified in the form of Bid; or
- (b) having been notified of the acceptance of our Bid by the TALCHER FERTILIZERS LIMITED during the period of bid validity:
 - (i) fail or refuse to execute the Contract, if required, or
 - (ii) fail or refuse to furnish the Contract Performance Security, in accordance provisions of tender document.
 - (iii) fail or refuse to accept 'arithmetical corrections' as per provision of tender document.
- (c) having indulged in corrupt/fraudulent /collusive/coercive practice as per procedure.

Place:
Date:

[Signature of Authorized Signatory of Bidder]
Name:
Designation:

Seal

F-3

LETTER OF AUTHORITY

[Pro forma for Letter of Authority for Attending 'Pre-Bid Meetings' /'Un-priced Bid Opening' / 'Price Bid Opening']

Ref:

Date:

To,
M/s TALCHER FERTILIZERS LIMITED,

SUB:
TENDER NO:

Dear Sir,

I/We, _____ hereby authorize the following representative(s) for attending any 'Meetings [Pre-Bid Meeting]', 'Un-priced Bid Opening' and 'Price Bid Opening' against the above Tender Documents:

[1] Name & Designation _____ Signature _____
Phone/Cell: _____

E-mail: @

[2] Name & Designation _____ Signature _____
Phone/Cell: _____

E-mail: @

We confirm that we shall be bound by all commitments made by aforementioned authorised representative(s).

Place: [Signature of Authorized Signatory of Bidder]
Date: Name:
Designation:
Seal:

- (i) Note: This "Letter of Authority" should be on the "**letter head**" of the Bidder and should be signed by a person competent and having the 'Power of Attorney' to bind the Bidder. Not more than 'two [02] persons per Bidder' are permitted to attend 'Pre-Bid Meetings' /'Un-priced Bid Opening' / 'Price Bid Opening'..
- (ii) Bidder's authorized representative is required to carry a copy of this authority letter while attending the 'Pre-Bid Meetings' /'Un-priced Bid Opening' .

F-4

PROFORMA OF "BANK GUARANTEE" FOR "CONTRACT PERFORMANCE SECURITY / SECURITY DEPOSIT"
(ON NON-JUDICIAL STAMP PAPER OF APPROPRIATE VALUE)

To, M/s Talcher Fertilizers Limited, Talcher	Bank Guarantee No.	
	Date of BG	
	BG Valid up to	
	Claim period up to (There should be three months gap between expiry date of BG & Claim period)	
	Stamp Sl. No./e-Stamp Certificate No.	

Dear Sir(s),

M/s. _____ having registered office at _____ (herein after called the "contractor" which expression shall wherever the context so require include its successors and assignees) have been placed/ awarded the job/work of _____ vide LOA /FOA No. _____ dated _____ for Talcher Fertilizers Limited having registered office at Plot 2/H, Kalpana Area, BJB Nagar, Khorda, Bhubaneswar-751014, Odisha (herein after called the "TFL" which expression shall wherever the context so require include its successors and assignees).

The Contract conditions provide that the CONTRACTOR shall pay a sum of Rs. _____ (Rupees _____) as full Contract Performance Guarantee in the form therein mentioned. The form of payment of Contract Performance Guarantee includes guarantee executed by Nationalized Bank/Scheduled Commercial Bank, undertaking full responsibility to indemnify Talcher Fertilizers Limited, in case of default.

The said M/s. _____ has approached us and at their request and in consideration of the premises we having our office at _____ have agreed to give such guarantee as hereinafter mentioned.

1. We _____ hereby undertake to give the irrevocable & unconditional guarantee to you that if default shall be made by M/s. _____ in performing any of the terms and conditions of the tender/order/contract or in payment of any money payable to Talcher Fertilizers Limited we shall on first demand pay without demur, contest, protest and/ or without any recourse to the contractor to TFL in such manner as TFL may direct the said amount of Rupees _____ only or such portion thereof not exceeding the said sum as you may require from time to time.

2. You will have the full liberty without reference to us and without affecting this guarantee, postpone for any time or from time to time the exercise of any of the powers and rights conferred on you under the order/contract with the said _____ M/s. _____ and to enforce or to forbear from endorsing any powers or rights or by reason of time being given to the said M/s. _____ and such postponement forbearance would not have the effect of releasing the bank from its obligation under this debt.
3. Your right to recover the said sum of Rs. _____ (Rupees _____) from us in manner aforesaid is absolute & unequivocal and will not be affected or suspended by reason of the fact that any dispute or disputes have been raised by the said M/s. _____ and/or that any dispute or disputes are pending before any officer, tribunal or court or arbitrator or any other authority/forum and any demand made by you in the bank shall be conclusive and binding. The bank shall not be released of its obligations under these presents by any exercise by you of its liberty with reference to matter aforesaid or any of their or by reason or any other act of omission or commission on your part or any other indulgence shown by you or by any other matter or changed what so ever which under law would, but for this provision, have the effect of releasing the bank.
4. The guarantee herein contained shall not be determined or affected by the liquidation or winding up dissolution or changes of constitution or insolvency of the said contractor but shall in all respects and for all purposes be binding and operative until payment of all money due to you in respect of such liabilities is paid.
5. The bank undertakes not to revoke this guarantee during its currency without your previous consent and further agrees that the guarantee shall continue to be enforceable until it is discharged by TFL in writing. However, if for any reason, the contractor is unable to complete the work within the period stipulated in the order/contract and in case of extension of the date of delivery/completion resulting extension of defect liability period/guarantee period of the contractor fails to perform the work fully, the bank hereby agrees to further extend this guarantee at the instance of the contractor till such time as may be determined by TFL. If any further extension of this guarantee is required, the same shall be extended to such required period on receiving instruction from M/s. _____ (contractor) on whose behalf this guarantee is issued.
6. Bank also agrees that TFL at its option shall be entitled to enforce this Guarantee against the bank (as principal debtor) in the first instant, without proceeding against the contractor and notwithstanding any security or other guarantee that TFL may have in relation to the /contractor's liabilities.
7. The amount under the Bank Guarantee is payable forthwith without any delay by Bank upon the written demand raised by TFL. Any dispute arising out of or in relation to the said Bank Guarantee shall be subject to the exclusive jurisdiction of courts at New Delhi.
8. Therefore, we hereby affirm that we are guarantors and responsible to you on behalf of the Contractor up to a total amount of _____ (amount of guarantees in words and figures) and we undertake to pay you, upon your first written demand declaring the Contractor to be in default under the order/contract and without caveat or argument, any sum or sums within the limits of (amounts of guarantee) as aforesaid, without your needing to prove or show grounds or reasons for your demand or the sum specified therein.

9. We have power to issue this guarantee in your favor under Memorandum and Articles of Association and the undersigned has full power to do under the Power of Attorney, dated _____ granted to him by the Bank.

10. Notwithstanding anything contained herein:

11.

- a) The Bank's liability under this Guarantee shall not exceed (currency in figures) _____ (currency in words only) _____
- b) This Guarantee shall remain in force upto _____ (this date should be expiry date of defect liability period of the Contract) and any extension(s) thereof; and
- c) The Bank shall be released and discharged from all liability under this Guarantee unless a written claim or demand is issued to the Bank on or before the midnight of _____ (indicate date of expiry of claim period which includes minimum three months from the expiry of this Bank Guarantee) and if extended, the date of expiry of the last extension of this Guarantee. If a claim has been received by us within the said date, all the rights of TFL under this Guarantee shall be valid and shall not cease until we have satisfied that claim.

Yours faithfully,

Bank by its Constituted Attorney

Signature of a person duly
Authorized to sign on behalf of the Bank

INSTRUCTIONS FOR FURNISHING
"CONTRACT PERFORMANCE SECURITY / SECURITY DEPOSIT" BY "BANK GUARANTEE"

1. The Bank Guarantee by successful Bidder(s) will be given on non-judicial stamp paper as per 'stamp duty' applicable. The non-judicial stamp paper should be in name of the issuing bank..
2. The Bank Guarantee by Bidders will be given from bank as specified in Cl no. 38.3 of ITB [Section-III] of Tender Document .
3. A letter from the issuing bank of the requisite Bank Guarantee confirming that said Bank Guarantee and all future communication relating to the Bank Guarantee shall be forwarded to Employer.
4. If a Bank Guarantee is issued by a commercial bank, then a letter to Employer and copy to Consultant (if applicable) confirming its net worth is more than Rs. 100,00,00,000.00 [Rupees One Hundred Crores] or its equivalent in foreign currency alongwith documentary evidence OR in the Bank Guarantee itself.
5. Contractor shall submit attached cover letter (Annexure) while submitting Contract Performance Security.

Form-4 (a)

**MATTER TO BE MENTIONED IN COVERING LETTER TO BE SUBMITTED BY VENDOR
ALONG WITH BANK GUARANTEE (BG)**

1. Bank Guarantee No.				
2. Vendor Name/ VENDOR CODE	NAME			
	VENDOR CODE			
BANK GUARANTEE AMOUNT				
PURCHASE ORDER/LOA				
1. Nature of Bank Guarantee [Please Tick (<input type="checkbox"/>) whichever is applicable]	Performance Security (CPS)	SECURITY DEPOSIT	ADVANCE	EMD
2. BG ISSUING Bank DETAILS:				
(A) E-MAIL ID				
(B) ADDRESS				
(C) Phone No. / Mobile No.				

F-5

AGREED TERMS & CONDITIONS

To,
M/s TALCHER FERTILIZERS LIMITED

SUB:
TENDER NO:

This Questionnaire duly filled in, signed & stamped must form part of Bidder's Bid and should be returned along with Un-priced Bid. Clauses confirmed hereunder need not be repeated in the Bid.

SI.	DESCRIPTION	BIDDER'S CONFIRMATION
1.	Bidder's name, Vendor Code of TFL (If any) and address	Bidder's Name: TFL's Vendor Code: Address:
2.	Bidder confirms the currency of quoted prices is in Indian Rupees	
3.	Bidder confirms quoted prices will remain firm and fixed till complete execution of the order (except where price escalation/variation is allowed in the Tender).	
4.	Bidder confirms that they have quoted GST (CGST & SGST/ UTGST or IGST) in Price Schedule / Schedule of Rates (SOR) of Price bid.	Confirmed
4.1	Whether in the instant tender services/works are covered in reverse charge rule of GST (CGST & SGST/UTGST or IGST) If yes, Bidder confirms that they have quoted rate of applicable GST (CGST & SGST/ UTGST or IGST) in Price Schedule / Schedule of Rates of Price Bid	
4.2	Indicate Harmonized System of Nomenclature (HSN)/Service Accounting Codes (SAC).	HSN/SAC Code (as applicable): <hr/>
4.3	Bidder hereby confirms that the quoted prices are in compliance with the Section 171 of CGST Act/ SGST Act as mentioned as clause no. 13.10 of ITB (Anti-profiteering clause).	
4.4	a. Whether bidder is liable to raise E-Invoice as per GST Act. b. If yes, bidder will raise E-Invoice and confirm compliance to provision of tender in this regard.	a. _____ b. _____
4.5	Whether bidder is liable to raise E-Invoice as per GST Act. If yes, bidder will raise E-Invoice and confirm compliance to provision of tender in this regard.	
5.	Bidder confirms acceptance of relevant Terms of Payment specified in the Bid Document.	
6.	Bidder confirms that Contract Performance Security will be furnished as per Bid Document within 30 days of FOA in case of	

SI.	DESCRIPTION	BIDDER'S CONFIRMATION				
	successful bidder.					
7.	Bidder confirms that Contract Performance Security shall be from any Indian scheduled bank or a branch of an International bank situated in India and registered with Reserve bank of India as scheduled foreign bank. However, in case of bank guarantees from banks other than the Nationalised Indian banks, the bank must be a commercial bank having net worth in excess of Rs 100 crores and a declaration to this effect shall be made by such commercial bank either in the Bank Guarantee itself or separately on its letterhead.					
8.	Bidder confirms compliance to Completion Schedule as specified in Bid document and the same shall be reckoned from the date of Fax of Acceptance.					
9.	(i) Bidder confirms acceptance of Mutually Agreed Damages for delay in completion schedule specified in Bid document. (ii) In case of delay, the bills/invoices shall be submitted after reducing the price reduction due to delay (refer MAD Clause).					
10.	a) Bidder confirms acceptance of all terms and conditions of Bid Document (all sections). b) Bidder confirms that printed terms and conditions of bidder are not applicable.					
11.	Bidder confirms that their offer is valid for period specified in BDS from Final/Extended due date of opening of Techno-commercial Bids.					
12.	Bidder have furnished EMD/Bid Security details as under: a) EMD/ Bid Security No. & date b) Value c) Validity d) Bank Address/e-mail ID/Mobile no. [in case of BG] OR Bidder furnishes bid security declaration [applicable for MSEs, Start-Ups and CPSEs (to whom exemption is allowed as per extant guidelines in vogue)]					
13.	As per requirement of tender, bidder (having status as Pvt. Ltd. or Limited company) must upload bid duly digitally signed on e-portal through class-3B digital signature (DS). In case, class of DS or name of employee or name of employer is not visible in the digitally signed documents, the bid digitally signed as submitted by the person shall be binding on the bidder.					
14.	Bidder confirms that (i) none of Directors (in Board of Director) of bidder is a relative of any Director (in Board of Director) of TFL or (ii) the bidder is not a firm in which any Director (in Board of Director) of TFL or their relative is a partner.	<table border="1"> <tr> <td>Confirmed</td> <td></td> </tr> <tr> <td>Not confirmed</td> <td></td> </tr> </table>	Confirmed		Not confirmed	
Confirmed						
Not confirmed						
15.	All correspondence must be in ENGLISH language only					

SI.	DESCRIPTION	BIDDER'S CONFIRMATION
16.	Bidder confirms the contents of this Tender Document have not been modified or altered by them. In case, it is found that the tender document has been modified / altered by the bidder, the bid submitted by them shall be liable for rejection.	
17.	Bidder confirms that all Bank charges associated with Bidder's Bank regarding release of payment etc. shall be borne by Bidder.	
18.	<p><u>No Deviation Confirmation:</u> It may be note that any 'deviation / exception' in any form may result in rejection of Bid. Therefore, Bidder confirms that they have not taken any 'exception / deviation' anywhere in the Bid. In case any 'deviation / exception' is mentioned or noticed, Bidder's Bid may be rejected.</p>	
19.	<p>If Bidder becomes a successful Bidder pursuant to the provisions of the Tender Document, the following Confirmation shall be automatically become enforceable:</p> <p>"We agree and acknowledge that the Employer is entering into the Contract/Agreement solely on its own behalf and not on behalf of any other person or entity. In particular, it is expressly understood & agreed that the Government of India is not a party to the Contract/Agreement and has no liabilities, obligations or rights thereunder. It is expressly understood and agreed that the Purchaser is authorized to enter into Contract/Agreement, solely on its own behalf under the applicable laws of India. We expressly agree, acknowledge and understand that the Purchaser is not an agent, representative or delegate of the Government of India. It is further understood and agreed that the Government of India is not and shall not be liable for any acts, omissions, commissions, breaches or other wrongs arising out of the Agreement. Accordingly, we hereby expressly waive, release and forego any and all actions or claims, including cross claims, VIP claims or counter claims against the Government of India arising out of the Agreement and covenants not to sue to Government of India as to any manner, claim, cause of action or things whatsoever arising of or under the Agreement."</p>	
20.	Bidder to ensure all documents as per tender including clause 11 of Section III of tender and all Formats are included in their bid.	
21.	Bidder understands that Tender Document is not exhaustive. In case any activity though specifically not covered in description of 'Schedule of Rates' but is required to complete the work as per Scope of Work, Conditions of Contract, or any other part of Bidding document, the quoted rates will deemed to be inclusive of cost incurred for such activities unless otherwise specifically excluded. Bidder confirms to perform for fulfilment of the contract and completeness of the supplies in all respect within the scheduled time frame and quoted price.	
22.	Bidder hereby confirms that they are not on 'Holiday' by OWNER or any of the JV partners of TFL (viz. GAIL, RCF, CIL, FCIL) or Public Sector Project Management Consultant (like PDIL, EIL, Mecon only due to "poor performance" or "corrupt and fraudulent	

SI.	DESCRIPTION	BIDDER'S CONFIRMATION
	<p>practices”) or banned by Government department/ Public Sector on due date of submission of bid.</p> <p>Further, Bidder confirms that neither they nor their allied agency/(ies) (as defined in the Procedure for Action in case of Corrupt/Fraudulent/Collusive/ Coercive Practices) are on banning list of TFL or any of the JV partner of TFL viz. GAIL, RCF, CIL, FCIL.</p> <p>Bidder also confirms that they are not under any liquidation, court receivership or similar proceedings or 'bankruptcy'.</p> <p>In case it comes to the notice of TFL/PDIL that the bidder has given wrong declaration in this regard, the same shall be dealt as 'fraudulent practices' and action shall be initiated as per the Procedure for action in case of Corrupt/Fraudulent/Collusive/Coercive Practices.</p> <p>Further, Bidder also confirms that in case there is any change in status of the declaration prior to award of contract, the same will be promptly informed to TFL/PDIL by them.</p>	
23	<p>Bidder confirms that (i) any variation in GST at the time of supplies for any reasons, other than statutory, including variations due to turnover, shall be borne by them and (ii) any error of interpretation of applicability of rate of GST (CGST & SGST/ UTGST or IGST) on components of an item and/or various items of tender by them shall be dealt as per clause no. 13.13 of Section-III of tender.</p>	
24	<p>Bidders confirm to submit signed copy of Integrity Pact (wherever included in tender).</p> <p>If Bidder is a partnership concern or a consortium, this agreement must be signed by all partners or consortium members.</p>	
25.	<p>Bidder confirms that, in case of contradiction between the confirmations provided in this format and to the terms & conditions mentioned elsewhere in the offer, the confirmations given in this format shall prevail.</p>	
26.	<p>Bidder's offer No. & Date</p>	
27	<p>Bidder confirms that there is no conflict of interest with other bidders, as per clause no.4.2 of Section-III (ITB) of Tender Document.</p>	

Place:
Date:

[Signature of Authorized Signatory of Bidder]
Name:
Designation:
Seal:

ACKNOWLEDGEMENT CUM CONSENT LETTER

(On receipt of tender document/information regarding the tender, Bidder shall acknowledge the receipt and confirm his intention to bid or reason for non-participation against the enquiry /tender through e-mail to concerned executive in TFL/PDIL issued the tender, by filling up the Format)

To,
**M/s TALCHER FERTILIZERS LIMITED
NOIDA**

SUB:
TENDER NO:

Dear Sir,

We hereby acknowledge receipt of a complete set of bidding documents along with enclosures for subject item/job and/or the information regarding the subject tender.

- We intend to bid as requested for the subject item/job and furnish following details with respect to our quoting office:

Postal Address with Pin Code :
Telephone Number :
Contact Person :
E-mail Address :
Mobile No. :
Date :
Seal/Stamp :

- We are unable to bid for the reason given below:

Reasons for non-submission of bid:

Agency's Name :
Signature :
Name :
Designation :
Date :
Seal/Stamp :

F-7
BIDDER'S EXPERIENCE

To,

**M/s TALCHER FERTILIZERS LIMITED
NOIDA**

SUB:
TENDER NO:

Sl. No	Detailed Description of Job	LOA/WO No. and date	Full Postal Address & phone nos. of Client. <i>Name, designation and address of Engineer/ Officer-in-Charge</i>	Capacity	Value of Contract/ Order (<i>Specify Currency Amount</i>)	Date of Commencement	Scheduled Completion Time (Months)	Date of Actual Completion	Reasons for delay in execution, if any	Details of satisfactory operation from the date of Acceptance
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)

Place:
Date:

[Signature of Authorized Signatory of Bidder]

Name:
Designation:

Seal:

Note:As per Note III of Clause No. A.1 of Section-II, only documents (Work Order, Completion certificate, Execution Certificate etc.) which have been referred/ specified in the bid shall be considered in reply to queries during evaluation of Bids.

F-8(A)
CHECK LIST

Bidders are requested to duly fill in the checklist. This checklist gives only certain important items to facilitate the bidder to make sure that the necessary data/information as called for in the bid document has been submitted by them along with their offer. This, however, does not relieve the bidder of his responsibilities to make sure that his offer is otherwise complete in all respects.

Please ensure compliance and tick (√) against following points:

S. No.	DESCRIPTION	CHECK BOX
1.0	Digitally Signing (in case of e-bidding)/ Signing and Stamping (in case of manual bidding) on each sheet of offer, original bidding document including SCC, ITB,GCC, SOR DRAWINGS Corrigendum (if any)	
2.0	Confirm that the following details have been submitted in the Un-priced part of the bid	
i	Covering Letter, Letter of Submission	
ii	EMD / Declaration for Bid Security as per provisions of Tender (as applicable)	
iii.	Digitally signed (in case of e-tendering) or 'signed & stamped (in case of Manual tender) tender document along with drawings and addendum (if any)	
iv	Power of Attorney in the name of person signing the bid.	
v	Confirm submission of document alongwith unpriced bid as per bid requirement (including cl.no.11.1.1 of Section-III of tender).	
3.0	Confirm that all format duly filled in are enclosed with the bid duly Digitally Signed (in case of e-bidding)/ / Signed and Stamped (in case of manual bidding) by authorised person(s)	
4.0	Confirm that the price part as per Price Schedule format submitted with Bidding Document/uploaded in case of e-bid.	
5.0	Confirm that Undertaking as per <i>Form-I to Annexure-V to Section-III of tender</i> and Certification from the statutory auditor or cost auditor of the company (in the case of companies) or from a practicing cost accountant or practicing chartered accountant (in respect of other than companies) as per <i>Form-II to Annexure-V of Section-II of tender</i> are submitted.	
6.0	Confirm that Undertaking as per Form-1to Annexure-VII have been submitted by the bidder (Guidelines from Procurement from a Country sharing a Land Border with India)	
7.0	Confirm submission of Checklist against Bid Evaluation Criteria as per format F-8(B)	

Place:

[Signature of Authorized Signatory of Bidder]

Date:

Name:

Designation:

F-8(B)
CHECKLIST FOR BID EVALUATION CRITERIA (BEC) QUALIFYING DOCUMENTS
(refer Section II of Tender document)

Sl. No.	Description	Documents required for qualification	Documents Submitted by Bidder	Documents attested as per Section-II of Tender	Reference Page No. of the Bid submitted
Technical BEC					
1.	Experience	<p>(a) Copy of Detailed Letter of Acceptance (DLOA) / Work Order /relevant extract of work Order/ Contract Agreement along with detailed scope of work and Completion / Acceptance Certificate. Such certificate shall be issued by order issuing authority/ Owner/End user.</p> <p>(b) The Detailed Letter of Acceptance (DLOA) / Work Order / Contract Agreement must inter alia include Scope of work, completion time, contract value, etc. Similarly, the Completion Certificate/ Acceptance Certificate must clearly indicate reference of relevant work order/DLOA/Contract Agreement, Name of Work, Completed order value and date of completion</p> <p>(c) Certificate in respect of minimum one year successful operation of the Plant/System from the date of acceptance/Commissioning of work issued by the Owner/End user shall be submitted.</p> <p>(d) Any other documents as per BEC requirement.</p>		Yes/No	
2.	Experience of bidder acquired as a subcontractor	certificate from end user		Yes/No	
3.	Job executed for Subsidiary / Fellow subsidiary/ Holding	Tax paid invoice(s) duly certified by statutory auditor of the bidder towards payment of statutory tax in support of the job executed for Subsidiary / Fellow subsidiary/ Holding company.		Yes/No	

	company.				
4.	Any other technical criteria in BEC	Bidder shall submit affidavit from the domestic manufacturers of such Iron & steel products as per the Form-I enclosed with the policy documents. A bidder who is not manufacturer of Iron & Steel product and is unable to submit the Affidavit from domestic manufacturers at bidding stage, such bidder can submit the Affidavit issued by domestic manufacturers after placement of order. In this case bidder along with his bid shall submit an undertaking as per prescribed format. Any other documents as per BEC requirement		Yes/No	
Financial BEC					
1.	Annual Turn Over	Audited Financial Statements [including Auditor's Report, Balance sheet, Profit & Loss Accounts statements, Notes & schedules etc.] for last Audited Financial Year. [In case the Annual Turnover criteria is not met in last Audited Financial Year, then the Audited Financial Statements for previous two years of last Audited Financial Year is to be submitted]	Submitted <i>(Mention specific year..... ...)</i>	Yes/No	
2.	Net Worth	Audited Financial Statements [including Auditor's Report, Balance sheet, Profit & Loss Accounts statements, Notes & schedules etc.] for last Audited Financial Year.	Submitted <i>(Mention specific year.....)</i>	Yes/No	
3.	Working Capital	Audited Financial Statements [including Auditor's Report, Balance sheet, Profit & Loss Accounts statements, Notes & schedules etc.] for last Audited Financial Year. If the bidder's working capital is negative or inadequate, the bidder shall submit a letter (in prescribed format) from their bank having net worth not less than Rs.100 Crores, confirming the availability of line of credit for at least working capital requirement as stated above.	Submitted <i>(Mention specific year..... ...)</i> Submitted/ Not Applicable <i>(Bidder to tick appropriate option)</i>	Yes/No	

4.	Format for Details of financial capability of Bidder	Bidder shall submit "Details of financial capability of Bidder" in prescribed format duly signed and stamped by a chartered accountant / Certified Public Accountant (CPA).	Submitted		

Place:
Date:

[Signature of Authorized Signatory of Bidder]
Name:
Designation:
Seal :

F-9

**FORMAT FOR CERTIFICATE FROM BANK
IF BIDDER'S WORKING CAPITAL IS INADEQUATE/NEGATIVE**

(To be provided on Bank's letter head)

Date:

To,
**M/s. TALCHER FERTILIZERS LIMITED
NOIDA**

Dear Sir,

This is to certify that M/s (name of the Bidder with address)
(hereinafter referred to as Customer) is an existing Customer of our Bank.

The Customer has informed that they wish to bid for TFL's Tender / NIT no.
..... dated for(Name of the
supply/work/services/consultancy) and as per the terms of the said Tender/NIT Document they have
to furnish a certificate from their Bank confirming the availability of line of credit.

Accordingly M/s (name of the Bank with address) confirms availability of
line of credit to M/s (name of the Bidder) for at least an amount of Rs.

It is also confirmed that the net worth of the Bank is more than Rs. 100 Crores (or Equivalent USD)
and the undersigned is authorized to issue this certificate.

Yours truly

for (Name & address of Bank)

(Authorized signatory)

Name of the signatory:

Designation :

Email Id :

Contact No. :

Stamp

Note:

**This Declaration/Letter for line of credit shall be from single bank only. Letters from multiple
banks shall not be applicable. However, banking syndicate will be acceptable wherein a
group of banks can jointly provide line of credit to the bidder.**

F-10

**FORMAT FOR CHARTERED ACCOUNTANT CERTIFICATE/ CERTIFIED PUBLIC
ACCOUNTANT (CPA) FOR FINANCIAL CAPABILITY OF THE BIDDER**

We have verified the Audited Financial Statements and other relevant records of M/s..... (Name of the bidder) and certify the following:

A. AUDITED ANNUAL TURNOVER* OF PRECEDING THREE FINANCIAL YEARS:

Year	Amount (Currency)
Year 1:	
Year 2:	
Year 3:	

B. NETWORTH* AS PER AUDITED FINANCIAL STATEMENT OF PRECEDING FINANCIAL YEAR:

Description	Year _____
	Amount (Currency)
1. Net Worth	

C. WORKING CAPITAL* AS PER AUDITED FINANCIAL STATEMENT OF PRECEDING FINANCIAL YEAR:

Description	Year _____
	Amount (Currency)
1. Current Assets	
2. Current Liabilities	
3. Working Capital (Current Assets-Current liabilities)	

****Refer Instructions***

Notes:

- (i) It is further certified that the above mentioned applicable figures are matching with the returns filed with Registrar of Companies (ROC) [Applicable only in case of Indian Companies]
- (ii) We confirm the above figures after referring instructions at page 2 of 2 of Format F-10.
- (iii) Practicing Chartered Accountants shall generate Unique Document Identification Number (UDIN) for all certificates issued by them.

Name of Audit Firm:
Chartered Accountant/CPA
Date:

[Signature of Authorized Signatory]

Name:
Designation:
Seal:
UDIN:

Membership No.:

Instructions for Format F-10:

1. The Separate Pro-forma shall be used for each member in case of JV/ Consortium (If applicable).
2. The financial year would be the same as one normally followed by the bidder for its Annual Report.
3. The bidder shall provide the audited annual financial statements as required for this Tender document. Failure to do so would result in the Proposal being considered as non- responsive.
4. For the purpose of this Tender document:
 - (i) **Annual Turnover** shall be “Revenue from Operations” as per Profit & Loss account of audited annual financial statements
 - (ii) **Working Capital** shall be “Current Assets less Current liabilities” and
 - (iii) **Net Worth** shall be Aggregate value of the paid-up share capital and all reserves created out of the profits and securities premium account, after deducting the aggregate value of the accumulated losses, deferred expenditure and miscellaneous expenditure not written off, if any, but does not include reserves created out of revaluation of assets, write back of depreciation and amalgamation.
5. **Above figures shall be calculated after considering the qualification, if any, made by the statutory auditor on the audited financial statements of the bidder including quantified financial implication.**
6. This certificate is to be submitted on the letter head of Chartered Accountant/CPA.

F-11

DELETED

F-12

BIDDER'S QUERIES FOR PRE BID MEETING

To,

M/s TALCHER FERTILIZERS LIMITED
NOIDA

SUB:

TENDER NO:

SI. NO.	REFERENCE OF TENDER DOCUMENT				BIDDER'S QUERY	OWNER'S REPLY
	SEC. NO.	Page No.	Clause No	Subject		

NOTE: The Pre-Bid Queries may be sent by e-mail before due date for receipt of Bidder's queries.

SIGNATURE OF BIDDER: _____

NAME OF BIDDER: _____

F-13

E-Banking Mandate Form

(To be issued on vendors letter head)

1. Vendor/customer Name :
2. Vendor/customer Code:
3. Vendor /customer Address:
4. Vendor/customer e-mail id:
5. Particulars of bank account
 - a) Name of Bank
 - b) Name of branch
 - c) Branch code:
 - d) Address:
 - e) Telephone number:
 - f) Type of account (current/saving etc.)
 - g) Account Number:
 - h) RTGS IFSC code of the bank branch
 - i) NEFT IFSC code of the bank branch
 - j) 9 digit MICR code

I/We hereby authorize TFL to release any amount due to me/us in the bank account as mentioned above. I/We hereby declare that the particulars given above are correct and complete. If the transaction is delayed or lost because of incomplete or incorrect information, we would not hold the TFL responsible.

(Signature of vendor/customer)

BANK CERTIFICATE

We certify that ----- has an Account no. ----- with us and we confirm that the details given above are correct as per our records.

Bank stamp

Date

(Signature of authorized officer of bank)

F-14

INTEGRITY PACT

INTEGRITY PACT



INTEGRITY PACT

INTRODUCTION:

TFL as one of its endeavour to maintain and foster most ethical and corruption free business environment, have decided to adopt the Integrity Pact, a tool developed by the Transparency International, to ensure that all activities and transactions between the Company (TFL) and its Counterparties (Bidders, Contractors, Vendors, Suppliers, Service Providers/Consultants etc.) are handled in a fair and transparent manner, completely free of corruption.

Considering the above, the details mentioned at attached Annexure-1 are applicable as stated in Instruction to Bidders of Bid Document in addition to the existing stipulation regarding Corrupt and Fraudulent Practices.

The attached copy of the Integrity Pact at Annexure - 2 shall be included in the Bid submitted by the bidder (to be executed by the bidder for all tenders of value Rs. 1 (One) crore and above). In case a bidder does not sign the Integrity Pact, his bid shall be liable for rejection.

ANNEXURE-1

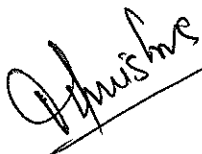

Bidder is required to sign the Integrity Pact with TFL as per format & terms and conditions enclosed with tender. In case a bidder does not sign the Integrity Pact, his bid shall be liable for rejection.

I COMMITMENTS AND OBLIGATIONS OF THE "COUNTERPARTY"

- a) The Counterparty, directly or indirectly (through agent, consultant, advisor, etc.), shall not pay any bribe/ influence or give undue/ unlawful benefit to anyone to gain undue advantage in dealing with TFL.
- b) The Counterparty will not engage in collusion of any kind including price fixation etc. with other Counterparts.
- c) The counterparty will not pass TFL's confidential information to any third party unless specifically authorized by TFL in writing.
- d) The Counterparties shall promote and observe best ethical practices within their respective organizations.
- e) The Counterparty shall inform the Independent External Monitor.
 - i) If it received any demand, directly or indirectly, for a bribe/ favour or any illegal gratification/ payment / benefit;
 - ii) If it comes to know of any unethical or illegal payment / benefit;
 - iii) If it makes any payment to any TFL associate.
- f) The Counterparty shall not make any false or misleading allegations against TFL or its associates.

II VIOLATIONS & CONSEQUENCES:

- a) If a Counterparty commits a violation of its Commitments and Obligations under the Integrity Pact Programme during bidding process, their entire Earnest Money Deposit/ Bid Security, would be forfeited and in addition, action shall be taken as per "Procedure for action in case Corrupt /Fraudulent/ Collusive/Coercive Practices"
- b) In case of violation of the Integrity pact by Counterparty after award of the Contract, TFL shall be entitled to terminate the Contract. Further, TFL would forfeit the security deposits/ Contract Performance Bank Guarantee and in addition, action shall be taken as per "Procedure for action in case Corrupt /Fraudulent/ Collusive/Coercive Practices"

INDEPENDENT EXTERNAL MONITORS (IEMS)

Presently the panel consisting of the following Independent External Monitors (IEMs) have been appointed by TFL, in terms of Integrity Pact (IP) which forms part of TFL Tenders / Contracts.

- i) Shri Sanjeev Prasad Narain Singh (Email ID: spns108@gmail.com)
- ii) Shri Anil Kumar Sharma (Email ID: aksharma1512@gmail.com)

This panel is authorised to examine / consider all references made to it under this tender/ contract. "The bidder(s), in case of any dispute(s) / complaint(s) pertaining to this tender falling under provisions of Integrity Pact may raise the same either directly with the IEMs on the panel viz Shri Sanjeev Prasad Narain Singh (Email ID: spns108@gmail.com) & Shri Anil Kumar Sharma (Email ID: aksharma1512@gmail.com) or with CC to them through their Nodal Officer - Sh. Vivek Mishra, Sr. Mgr. (C&P) – Email: vivekmishra@tflonline.co.in, Address: Talcher Fertilizers Limited, Administrative Building, Post – Vikrampur, Dist. Angul, Odisha - 759106. On receipt of such complaints/representations, Nodal Officer shall coordinate with IEM Panel and TFL authorities concerned for their disposal as per extant guidelines."

Vivek Mishra



INTEGRITY PACT

(To be executed on plain paper)

Between Talcher Fertilizers Limited (TFL) [here-in-after referred to as "Principal"].

AND

_____ (here-in-after referred to as "The Bidder/ Contractor").

(Principal and the Bidder / Contractor are here-in-after are referred to individually as "Party" or collectively as "Parties").

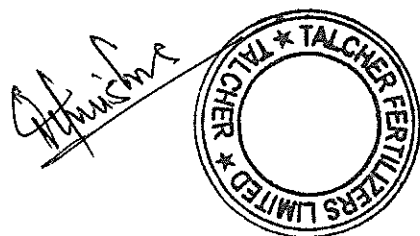
PREAMBLE

The Principal intends to award under laid down organizational procedures, contract/s for _____. The Principal values full compliance with all relevant laws of land rules, regulations, and economic use of resources and of fairness /transparency in its relations with its Bidder (s) and/or Contractor (s).

In order to achieve these goals, the Principal will appoint Independent External Monitors (IEMs) who will monitor the tender process and the execution of the contract for compliance with the principles mentioned above.

Section 1 – Commitments of the Principal

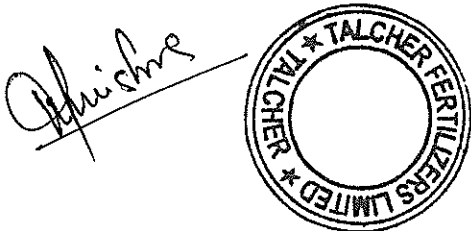
1. The Principal commits itself to take all measures necessary to prevent corruption and to observe the following Principles:-
 - i) No employee of the Principal, personally or through family members, will in connection with the tender for, or the execution of a contract, demand, take a promise for or accept, for self or for a third person, any material or immaterial benefit which the person is not legally entitled to.
 - ii) The Principal will, during the tender process treat all Bidder(s) with equity and reasons. The Principal will in particular, before and during the tender process, provide to all Bidder(s) the same information and will not provide to any Bidder(s) confidential / additional information through which the Bidder(s) could obtain an advantage in relation to the tender process or the contract execution.



- iii) The Principal will exclude from the process all known prejudiced persons.
2. If the Principal obtains information on the conduct of any of its employees which is a criminal offence under the Indian Penal Code (IPC) / Prevention of Corruption Act (PC Act), or if there be a substantive suspicion in this regard, the Principal will inform the Chief Vigilance Officers and in addition can initiate disciplinary actions.

Section 2 – Commitments of the Bidder (s)/Contractor (s)

1. The Bidder(s) / Contractor(s) commits themselves to take all measures necessary to prevent corruption. The Bidder(s) / Contractor(s) commits themselves to observe the following principles during participation in the tender process and during the contract execution:
- i) The Bidder (s) / Contractor (s) will not, directly or through any other person or firm, offer, promise or give to any of the Principal's employees involved in the tender process or the execution of the contract or to any third person any material or other benefit which he / she is not legally entitled to, in order to obtain in exchange any advantage of any kind whatsoever during the tender process or during the execution of the contract.
- ii) The Bidder (s) / Contractor (s) will not enter with other Bidders into any undisclosed agreement or understanding, whether formal or informal. This applies in particular to prices, specifications, certifications, subsidiary contracts, submission or non-submission of bids or any other action to restrict competitiveness or to introduce cartelisation in the bidding process.
- iii) The Bidder (s) / Contractor (s) will not commit any offence under the relevant IPC/PC Act; further, the Bidder (s) / Contractor (s) will not use improperly, for purposes of competition or personal gain, or pass on to others, any information or document provided by the Principal as part of the business relationship, regarding plans, technical proposals and business details, including information contained or transmitted electronically.
- iv) The Bidder (s)/ Contractor (s) of foreign origin shall disclose the name and address of the Agents/ representatives in India, if any. Similarly, the Bidder (s)/ Contractor (s) of Indian Nationality shall furnish the name and address of the foreign principals, if any. Further, all the payments made to the Indian agent/ representative have to be in India Rupees only.
- v) The Bidder (s) / Contractor (s) will, when presenting their bid, disclose any and all payments made, is committed to or intends to make to agents,



brokers or any other intermediaries in connection with the award of the contract.

vi) Bidder(s) / Contractor(s) who have signed the Integrity Pact shall not approach the Courts while representing the matter to IEMs and shall wait for their decision in the matter.

2. The Bidder(s)/ Contractor(s) shall not instigate third person to commit offences outlined above or be an accessory to such offences.

Section 3 – Disqualification from tender process and exclusion from future contracts

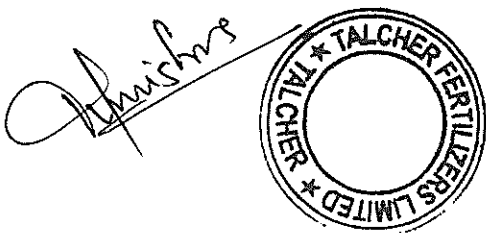
If the Bidder (s) / Contractor (s), before award or during execution has committed a transgression through a violation of Section 2, above or in any other form such as to put their reliability or credibility in question, the Principal is entitled to disqualify the Bidder (s) / Contractor (s) from the tender process or take action as per provisions of "Procedure for action in case Corrupt /Fraudulent/ Collusive/Coercive Practices".

Section 4 – Compensation for Damages

1. If the Principal has disqualified the Bidder (s) from the tender process prior to the award according to Section 3, the Principal is entitled to demand and recover the damages equivalent to Earnest Money Deposit / Bid Security.
2. If the Principal has terminated the contract according to Section 3, or if the Principal is entitled to terminate the contract according to Section 3, the Principal shall be entitled to demand and recover from the Contractor liquidated damages equal to the Contract Value or the amount equivalent to Performance Bank Guarantee.

Section 5 – Previous transgression

1. The Bidder declares that no previous transgression occurred in the last three years, with any other Company in any country conforming to the anti-corruption approach or with any Public Sector Enterprise in India that could justify his exclusion from the tender process.
2. If the Bidder makes incorrect statement on this subject, he can be disqualified from the tender process or actions can be taken as per provisions of "Procedure for action in case Corrupt /Fraudulent/ Collusive/Coercive Practices"

A handwritten signature in black ink is written over a circular stamp. The stamp contains the text "TALCHER FERTILIZERS LIMITED" around the perimeter and "TALCHER" in the center.

Section 6 – Equal treatment to all Bidders / Contractors / Subcontractors

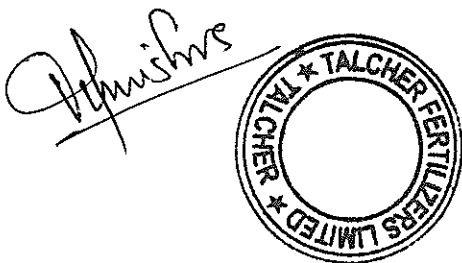
1. In case of sub-contracting, the Principal contractor shall take the responsibility of the adoption of IP by the sub-contractor. It is to be ensured by him that all sub-contractors also sign the IP.
2. The Principal will enter into agreements with identical conditions as this one with all Bidders and Contractors.
3. The Principal will disqualify from the tender process all bidders who do not sign this Pact or violate its provisions.

Section 7 – Criminal charges against violating Bidder (s) / Contractor (s) / Sub-contractor (s)

If the Principal obtains knowledge of conduct of a Bidder, Contractor or Subcontractor, or of an employee or a representative or an associate of a Bidder, Contractor or Subcontractor which constitutes corruption, or if the Principal has substantive suspicion in this regard, the Principal will inform the same to the Chief Vigilance Officer.

Section 8 –Independent External Monitor / Monitors

1. The Principal appoints competent and credible Independent External Monitor for this Pact after approval by Central Vigilance Commission. The task of the Monitor is to review independently and objectively, whether and to what extent the parties comply with the obligations under this agreement.
2. The Monitor is not subject to instructions by the representatives of the parties and performs his/her functions neutrally and independently. The Monitor would have access to all documents / records pertaining to the contract for which a complaint or issue is raised before them, as and when warranted. However, the documents / records / information having National Security implications and those documents which have been classified as Secret/Top Secret are not to be disclosed. It will be obligatory for him/her to treat the information and documents of the Bidders / Contractors as confidential. He / she reports to MD, TFL.
3. The Bidder (s)/ Contractor (s) accepts that the Monitor has the right to access without restriction to all Project documentation of the Principal including that provided by the Contractor. The Contractor will also grant the Monitor, upon his/her request and demonstration of a valid interest, unrestricted and unconditional access to their project documentation. The same is applicable to Sub-contractors.
4. The Principal will provide to the Monitor sufficient information about all meetings among the parties related to the Project provided such meetings could have an



impact on the contractual relations between the Principal and the Contractor. The parties offer to the Monitor the option to participate in such meetings.

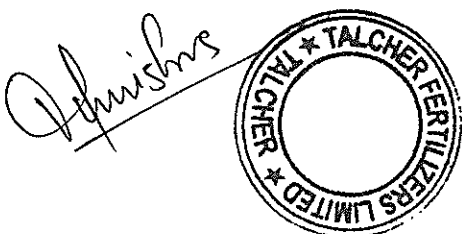
5. As soon as the Monitor notices, or believes to notice, a violation of this agreement, he/she will so inform the Management of the Principal and request the Management to discontinue or to take corrective action, or to take other relevant action. The monitor can in this regard submit non-binding recommendations. Beyond this, the Monitor has no right to demand from the parties that they act in a specific manner, refrain from action or tolerate action.
6. The Monitor will submit a written report to MD, TFL within 30 days from the date of reference or intimation to him by the 'Principal' and, should the occasion arise, submit proposals for correcting problematic situations.
7. If the Monitor has reported to MD, TFL, a substantiated suspicion of an offence under relevant IPC/PC Act, and MD, TFL has not, within reasonable time, taken visible action to proceed against such offence or reported it to the Chief Vigilance Officer, then, only in case of very serious issue having a specific verifiable Vigilance angle, the matter should be reported directly to the Central Vigilance Commission.
8. The word 'Monitor' would include both singular and plural.
9. In case of any complaints referred under IP Program, the role of IEMs is advisory and would not be legally binding and it is restricted to resolving the issues raised by an intending bidder regarding any aspect of the tender which allegedly restricts competition or bias towards some bidder.
10. After award of contract, the IEMs shall look into any issue relating to execution of contract, if specifically raised before them. As an illustrative example, if a contractor who has been awarded the contract, during the execution of contract, raises issue of delayed payment etc. before the IEMs, the same shall be examined by the panel of IEMs.

Section 9 – Pact Duration

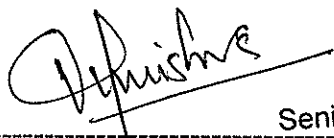
This Pact begins when both parties have legally signed it. It expires for the Contractor 12 months after the last payment under the respective contract, and for all other Bidders 6 months after the contract has been awarded. Any violation to the same would entail disqualification of the bidders and exclusion from future business dealing.

If any claim is made / lodged during this time, the same shall be binding and continue to be valid despite the lapse of this pact as specified above, unless it is discharged/determined by MD, TFL.

Section 10 – Miscellaneous provisions



1. This agreement is subject to Indian Law. Place of performance and exclusive jurisdiction is the Registered Office of the Principal, i.e. New Delhi.
2. Changes and supplements as well as termination notices, if any, need to be made in writing. Side agreements have not been made.
3. If the Contractor/Bidder is a Joint Venture or a partnership concern or a consortium, this agreement must be signed by all partners or consortium members.
4. Should one or several of the provisions of this agreement turn out to be invalid, the remainder of this agreement shall remain valid. In this case, the parties will strive to come to an agreement to their original intentions in such a case.
5. Issues like warranty / guarantee, etc. shall be outside the purview of IEMs.
6. In the event of any contradiction between the Integrity Pact and its Annexure, the Clause in Integrity Pact will prevail.



 Vivek Mishra
 Senior Manager (C&P)
 Talcher Fertilizers Limited
 Talcher, Odisha
 (For & on Behalf of Principal)


 (Office Seal)

 (For & on Behalf of Bidder/Contractor)

 (Office Seal)

Place -----
 Date -----

Witness 1:
 (Sign, Name & Address)
 [FOR PRINCIPAL]



 B. SUNIL PATRO, DY. MGR,
 TFL, TALCHER, ANGUL, ODISHA

Witness 2:
 (Sign, Name & Address)
 [FOR BIDDER / CONTRACTOR]

.....

INDEMNITY BOND

WHEREAS TALCHER FERTILIZERS LIMITED (hereinafter referred to as “**TFL**”) which expression shall, unless repugnant to the context include its successors and assigns, having its registered office at Plot 2/H, Kalpana Area, BJB Nagar, Khorda, Bhubaneswar – 751014 has entered into a contract with M/s*..... (hereinafter referred to as the “**Contractor**”) which expression shall unless repugnant to the context include its representatives, successors and assigns, having its registered office at *..... and on the terms and conditions as set out, inter-alia in the **[mention the work order/FOA/Tender No.]** and various documents forming part thereof, hereinafter collectively referred to as the ‘**CONTRACT**’ which expression shall include all amendments, modifications and / or variations thereto.

TFL has also advised the Contractor to execute an Indemnity Bond in general in favour of TFL indemnifying TFL and its employees and Directors including Independent Directors from all consequences which may arise out of any prospective litigation or proceedings filed or may be initiated by any third party, including any Banker / financial institution / worker(s) /vendor(s)/ subcontractor(s) etc. who may have been associated or engaged by the Contractor directly or indirectly with or without consent of TFL for above works.

NOW, THEREFORE, in consideration of the promises aforesaid, the Contractor hereby irrevocably and unconditionally undertakes to indemnify and keep indemnified TFL and all its employees, Directors, including Independent Directors, from and against all/any claim(s), damages, loss, which may arise out of any litigations/ liabilities that may be raised by the Contractor or any third party against TFL under or in relation to this contract. The Contractor undertakes to compensate and pay to TFL and/or any of its employees, Directors including Independent Directors, forth with on demand without any protest the amount claimed by TFL for itself and for and on behalf of its employees, Directors including Independent Directors together with direct/indirect expenses including all legal expenses incurred by them or any of them on account of such litigation or proceedings.

AND THE CONTRACTOR hereby further agrees with TFL that:

- (i) This Indemnity shall remain valid and irrevocable for all claims of TFL and/or any of its employees and Directors including Independent Directors arising out of said contract with respect to any such litigation / court case for which TFL and/or its employees and Directors including Independent Directors has been made party until now or here-in-after.
- (ii) This Indemnity shall not be discharged/ revoked by any change/ modification/ amendment/ assignment of the contract or any merger of the Contractor with other entity or any change in the constitution/structure of the Contractor’s firm/ Company or any conditions thereof including insolvency etc. of the Contractor, but shall be in all respects and for all purposes binding and operative until any/ all claims for payment of TFL are settled by the Contractor and/or TFL discharges the Contractor in writing from this Indemnity.

The undersigned has full power to execute this Indemnity Bond for and on behalf of the Contractor and the same stands valid.

SIGNED BY :
For [Contractor]

Authorised Representative

Place:

Dated:

Witnesses:1.

F-16

FREQUENTLY ASKED QUESTIONS (FAQs)

SL.NO.	QUESTION	ANSWER
1.0	Can any vendor quote for subject Tender?	Yes. A Vendor has to meet Bid Evaluation Criteria given under Section II of Tender document in addition to other requirements.
2.0	Should the Bid Evaluation Criteria documents be attested?	Yes. Please refer Section II of Tender document
3.0	Is attending Pre Bid Meeting mandatory.	No. Refer Clause No. 17 of Instruction to Bidders of Tender Document. However attending Pre Bid Meeting is recommended to sort out any issue before submission of bid by a Bidder.
4.0	Can a vendor submit more than 1 offer?	No. Please refer Clause No. 4 of Instruction to Bidders of Tender Document.
5.0	Is there any Help document available for e-Tender.	Refer FAQs as available on CPP Portal e-Procurement).
6.0	Are there are any MSE (Micro & Small Enterprises) benefits available?	Refer Clause No. 40 of Instructions to Bidders of Tender Document.
7.0	Are there are any benefits available to Startups?	Refer Clause No. 49 of Instructions to Bidders of Tender Document.

All the terms and conditions of Tender remain unaltered.

NOT APPLICABLE

Form F-17

**PROFORMA OF BANK GUARANTEE FOR MOBILISATION ADVANCE
(ON NON-JUDICIAL PAPER OF APPROPRIATE VALUE)**

To, M/s Talcher Fertilizers Limited, Noida	Bank Guarantee No.	
	Date of BG	
	BG Valid up to	
	Claim period up to (There should be three months gap between expiry date of BG & Claim period)	
	Stamp Sl. No. / e-Stamp Certificate No.	

Dear Sir(s),

In consideration of the Talcher Fertilizers Limited, hereinafter called the "Owner" which expression shall unless repugnant to the context or meaning thereof include its successors, executors, administrators and assignees, having awarded to M/s..... having its registered office at hereinafter referred as the 'CONTRACTOR', which expression shall unless repugnant to the context or meaning thereof, include its successors, administrators, executors and assignees, a contract hereinafter referred to as the 'Contract' for related works..... referred to as the 'WORK' on terms and conditions set out, inter-alia in the Owner's Contract / DLOA / FOA No.....dated..... valued at..... (in words & figures) and as the Owner having agreed to make an advance payment (herein after referred as Mobilization advance) for the performance of the above contract to the CONTRACTOR amounting to.....(in words & figures) as an advance against Bank Guarantee to be furnished by the CONTRACTOR.

We..... hereinafter referred to as the BANK which expression shall, unless repugnant to the context or meaning thereof, include its successors, administrators, executors and assignees having our office at..... do hereby undertake to give the irrevocable and unconditional guarantee and do hereby undertake to pay the OWNER on first demand without any demur, reservation, contest, recourse, protest and without reference to the CONTRACTOR any and all monies payable by the CONTRACTOR by reason of any breach by the said CONTRACTOR of any of the terms and conditions of the said Contract to the extent of..... till the said advance is adjusted as aforesaid at any time upto..... We agree that the guarantee herein contained shall continue to be enforceable till the sum due to the Owner on account of the said advance is adjusted/ recovered in full as aforesaid or till the Owner discharges this guarantee **in writing.**

The OWNER shall have the fullest liberty without affecting in any way the liability of the BANK under this guarantee, from time to time to vary the advance or to extend the time for performance of the works by the CONTRACTOR. The BANK shall not be released from its liability under these presents by any exercise of the Owner of the liberty with reference to the matter aforesaid.

The Owner shall have the fullest liberty, without reference to CONTRACTOR and without affecting this guarantee to postpone for any time or from time to time the exercise of any powers vested in them or of any right which they might have against the CONTRACTOR, and to exercise the same at any time in any manner, and either to enforce or to forebear to enforce any power, covenants contained or implied in the Contract between the OWNER and the CONTRACTOR or any other course or remedy or security available to the OWNER and the BANK shall not be released of its obligations under these presents by any exercise by the OWNER of its liberty with reference to matters aforesaid or other acts of omission or commission on the part of the OWNER or any other law would, but for this provision, have the effect of releasing the BANK.

The right of the OWNER to recover the outstanding sum of advance upto Rs.....from the BANK in the manner aforesaid **is absolute and unequivocal and** will not be affected or suspended by reason of the fact that any dispute or disputes has or have been raised by the CONTRACTOR and/or that any dispute or disputes is or are pending before any officer, tribunal or court **or arbitrator or any other authority/forum** and any demand made by OWNER on the BANK shall be conclusive and binding.

The BANK further undertakes not to revoke this guarantee during its currency without previous consent of the OWNER and further agrees that the guarantee contained shall continue to be enforceable **until it is discharged by TFL in writing.**

The BANK also agrees that the OWNER shall at its option be entitled to enforce this guarantee against the BANK as a principal debtor, in the first instance, notwithstanding any other security or guarantee that OWNER may have in relation to the CONTRACTOR's liabilities towards the said advance.

The amount under the Bank Guarantee is payable forthwith without any delay by Bank upon the written demand raised by TFL. Any dispute arising out of or in relation to the said Bank Guarantee shall be subject to the exclusive jurisdiction of courts at New Delhi.

Therefore, we hereby affirm that we are guarantors and responsible to you on behalf of the Contractor up to a total amount of _____(amount of guarantees in words and figures) and we undertake to pay you, upon your first written demand declaring the Contractor to be in default under the contract and without caveat or argument, any sum or sums within the limits of _____(amount of guarantee) as aforesaid, without your needing to prove or show grounds or reasons for your demand or the sum specified therein.

We have power to issue this guarantee in your favour under Memorandum and Articles of Association and the undersigned has full power to do so under the Power of Attorney/ resolution of the Board of Directors dated..... accorded to him by the BANK.

Notwithstanding anything contained herein:

- a) The Bank's liability under this Guarantee shall not exceed (currency in figures) _____ (currency in words only) _____
- b) This Guarantee shall remain in force upto _____ (three months beyond Completion Period) and any extension(s) thereof; and
- c) The Bank shall be released and discharged from all liability under this Guarantee unless a written claim or demand is issued to the Bank on or before the midnight of _____ (indicate date of expiry of claim period which includes minimum three months from the expiry of this Bank Guarantee) and if extended, the date of expiry of the last extension of this Guarantee. If a claim has been received by us within the said date, all the rights of TFL under this Guarantee shall be valid and shall not cease until we have satisfied that claim.

Dated.....this.....day of.....20

Signed by

(Person duly authorised by Bank)

Place:

WITNESS :

1..... (Signature)

..... (Printed Name)

..... (Designation)

2..... (Signature)

..... (Printed Name)

..... (Designation)

(Common Seal)

F-17 (A)
MATTER TO BE MENTIONED IN COVERING LETTER TO BE SUBMITTED BY
VENDOR ALONG WITH BANK GUARANTEE (BG)

1. Bank Guarantee No.		
2. Vendor Name		
3. Nature of Bank Guarantee [Please Tick (☐) whichever is applicable]	Contract Performance	
	Security (CPS)	Advance
Purchase Order (PO) / Fax of Acceptance (FOA) / Detailed Letter of Acceptance (DLOA) No.		
Details of Bank issuing Bank Guarantee (BG)		
A. Name		
B. E-mail ID		
C. Address		
D. Phone No. / Mobile No.		

**PROFORMA FOR BANK GUARANTEE FOR PAYMENTS TOWARDS PLACEMENT OF ALL
PURCHASE ORDERS OF MAJOR TAGGED ITEMS.**

(To be submitted on Rs. 500/-(five hundred) non judicial stamp paper)

Ref.....

Bank Guarantee No.-----

Date.....

To,

M/s Talcher Fertilizers Limited

Dear Sir(s),

In consideration of the Talcher Fertilizers Limited, hereinafter called the "Owner" which expression shall unless repugnant to the context or meaning thereof include its successors, executors, administrators and assignees, having awarded to M/s..... having its registered office at hereinafter referred as the 'CONTRACTOR', which expression shall unless repugnant to the context or meaning thereof, include its successors, administrators, executors and assignees, a contract hereinafter referred to as the 'Contract' for related works..... referred to as the 'WORK' on terms and conditions set out, inter-alia in the Owner's Contract / DLOA / FOA No.....dated..... valued at..... (in words & figures) and as the Owner having agreed to make milestone payments (for the performance of the above contract to the CONTRACTOR amounting to.....(in words & figures) against Bank Guarantee to be furnished by the CONTRACTOR.

We..... hereinafter referred to as the BANK which expression shall, unless repugnant to the context or meaning thereof, include its successors, administrators, executors and assignees having our office at..... do hereby undertake to give the irrevocable and unconditional guarantee and do hereby undertake to pay the OWNER on first demand without any demur, reservation, contest, recourse, protest and without reference to the CONTRACTOR any and all monies payable by the CONTRACTOR by reason of any breach by the said CONTRACTOR of any of the terms and conditions of the said Contract to the extent of.....We agree that the guarantee herein contained shall continue to be enforceable till the Owner discharges this guarantee **in writing.**

The OWNER shall have the fullest liberty without affecting in any way the liability of the BANK under this guarantee, from time to time to vary the amount or to extend the time for performance of the works by the CONTRACTOR. The BANK shall not be released from its liability under these presents by any exercise of the Owner of the liberty with reference to the matter aforesaid.

The Owner shall have the fullest liberty, without reference to CONTRACTOR and without affecting this guarantee to postpone for any time or from time to time the exercise of any powers vested in them or of any right which they might have against the CONTRACTOR, and to exercise the same at any time in any manner, and either to enforce or to forebear to enforce any power, covenants contained or implied in the Contract between the OWNER and the CONTRACTOR or any other course or remedy or security available to the OWNER and the BANK shall not be released of its obligations under these presents by any exercise by the OWNER of its liberty with reference to matters aforesaid or other acts of omission or commission on the part of the OWNER or any other law would, but for this provision, have the effect of releasing the BANK.

The right of the OWNER to recover the outstanding sum upto Rs..... from the BANK in the manner aforesaid **is absolute and unequivocal and** will not be affected or suspended by reason of the fact that any dispute or disputes has or have been raised by the CONTRACTOR and/or that any dispute or disputes is or are pending before any officer, tribunal or court **or arbitrator or any other authority/forum** and any demand made by OWNER on the BANK shall be conclusive and binding.

The BANK further undertakes not to revoke this guarantee during its currency without previous consent of the OWNER and further agrees that the guarantee contained shall continue to be enforceable **until it is discharged by TFL in writing.**

The BANK also agrees that the OWNER shall at its option be entitled to enforce this guarantee against the BANK as a principal debtor, in the first instance, notwithstanding any other security or guarantee that OWNER may have in relation to the CONTRACTOR's liabilities towards the said milestone payment .

The amount under the Bank Guarantee is payable forthwith without any delay by Bank upon the written demand raised by TFL. Any dispute arising out of or in relation to the said Bank Guarantee shall be subject to the exclusive jurisdiction of courts at New Delhi.

Therefore, we hereby affirm that we are guarantors and responsible to you on behalf of the Contractor up to a total amount of _____(amount of guarantees in words and figures) and we undertake to pay you, upon your first written demand declaring the Contractor to be in default under the contract and without caveat or argument, any sum or sums within the limits of _____(amount of guarantee) as aforesaid, without your needing to prove or show grounds or reasons for your demand or the sum specified therein.

Notwithstanding anything contained hereinabove, our liability under this guarantee is restricted to _____ and it will remain in force upto and including _____ (this date shall be initially 15 months from date of FOA) and shall be extended from time to time for such periods as may be advised by M/s_____ on whose behalf this guarantee has been given.

We have power to issue this guarantee in your favour under Memorandum and Articles of Association and the undersigned has full power to do so under the Power of Attorney/ resolution of the Board of Directors dated..... accorded to him by the BANK.

Notwithstanding anything contained herein:
9.

- a) The Bank's liability under this Guarantee shall not exceed (currency in figures) _____ (currency in words only) _____
- b) This Guarantee shall remain in force upto _____ (this date shall be initially 15 months from date of FOA) and any extension(s) thereof; and
- c) The Bank shall be released and discharged from all liability under this Guarantee unless a written claim or demand is issued to the Bank on or before the midnight of _____ (indicate date of expiry of claim period which includes minimum three months from the expiry of this Bank Guarantee) and if extended, the date of expiry of the last extension of this Guarantee. If a claim has been received by us within the said date, all the rights of TFL under this Guarantee shall be valid and shall not cease until we have satisfied that claim.

Dated.....this.....day of.....20

Signed by

(Person duly authorised by Bank)

Place:

WITNESS :

1..... (Signature)
..... (Printed Name)
..... (Designation)

2..... (Signature)
..... (Printed Name)
..... (Designation)

(Common Seal)

F-19

FORMAT OF LETTER OF NO DEVIATIONS
(ON BIDDER'S LETTERHEAD)

(NIT NO : PNMM/PC-183/E-4013/NCB DATED 10.03.2022)

We * hereby agree to fully comply with, abide by and accept without variation, deviation or reservation all technical, commercial and other condition whatsoever of the Bidding Documents and all Addenda / Corrigenda / Amendment/ Clarifications issued by OWNER.

We further hereby confirm that the bid is submitted in accordance of Tender Document and contains no deviation and the price bid submitted may be treated to conform to, in all respects, with the terms and conditions of the said tender documents including all Addenda / Corrigenda/ Amendment /Clarifications.

For and on behalf of* :

Stamp & Signature** :

Name :

Designation :

Date :

***Here fill in the name of bidder.**

****The Letter of *No Deviation* must be signed by the person (s) authorized to sign as per POA.**

F-20
POWER OF ATTORNEY (POA)
(To be submitted on the Non-Judicial stamp paper / Company's Letter Head)

TENDER NO:

Description of work:

Name of Bidder: _____

"The undersigned _____ (Name of LEGAL PERSON, i.e. CEO/C&MD/Company Secretary/Partners) is lawfully authorized to issue this POA* on behalf of the company M/s _____ (Name of bidder) whose registered address is _____ and does hereby appoint Mr./Ms _____ (name of authorized person signing the bid document) _____ (Designation) of M/s _____ (Name of bidder) whose signature appears below to be the true and lawful attorney/(s) and authorize him/her to sign the bid (both physically & digitally on CPP Portal), conduct negotiation, sign contracts and execute all the necessary matter related thereto, in the name and on behalf of the company in connection with the tender no. _____.

The signature of the authorized person/(s) herein constitutes unconditional obligations of M/s _____ (Name of bidder).

This Power of Attorney (POA) shall remain valid and in full force and effect before we withdraw it in writing (by fax, or mail or post). All the documents signed (within the period of validity of the Power of Attorney) by the authorized person herein shall not be invalid because of such withdrawal.

(*) In case of a single Bidder, the Power of Attorney shall be issued as per the constitution of the bidder as below.

- a) **In case of Proprietorship:** By Proprietor
- b) **In case of Partnership:** by all Partners or Managing Partner.
- c) **In case of Limited Liability Partnership:** by any bidder's employee authorized in terms of Deed of LLP.
- d) **In case of Public /Limited Company:** POA in favour of authorized employee(s) by Board of Directors through Board Resolution or by the designated officer authorized by Board to do so. Such Board Resolution should be duly countersigned by Company Secretary / MD / CMD / CEO.

SIGNATURE OF THE LEGAL PERSON

(Name of person with Company seal)

SIGNATURE OF THE AUTHORIZED PERSON
(FOR SIGNING THE BID)

(Signature)
Name of person: _____
E-mail id: _____
DSC (Digital Signature Certificate) No.: _____

F-21

UNDERTAKING REGARDING SUBMISSION OF ELECTRONIC INVOICE (E-INVOICE AS PER GST LAWS)

(to be submitted on letter head along with documents for release of payment)

To,
M/s TALCHER FERTILIZERS LIMITED

SUB:
LOA NO:
Dear Sir,

We _____ (Name of the Supplier/Contractor/Service Provider/ Consultant) hereby confirm that E-Invoice provision as per the GST Law is

- (i) Applicable to us []
- (ii) Not Applicable to us []

(Supplier/Contractor/Service Provider/ Consultant is to tick appropriate option (✓ or X) above).

In case, same is applicable to us, we confirm that we will submit E-Invoice after complying with all the requirements of GST Laws. If the invoice issued without following this process, such invoice can-not be processed for payment by TFL as no ITC is allowed on such invoices. We also confirm that If input tax credit is not available to TFL for any reason attributable to Supplier/Contractor/Service Provider/ Consultant (both for E-invoicing cases and non-E-invoicing cases), then TFL shall not be obligated or liable to pay or reimburse GST (CGST & SGST/UTGST or IGST) claimed in the invoice(s) and shall be entitled to deduct / setoff / recover such GST amount (CGST & SGST/UTGST or IGST) or Input Tax Credit amount together with penalties and interest, if any, by adjusting against any amounts paid or becomes payable in future to the Supplier/Contractor/Service Provider/ Consultant under this contract or under any other contract.

Place: [Signature of Authorized Signatory of Bidder]

Date: Name:
Designation:
Bidder Name:
Seal:

Form F-22

**UNDERTAKING REGARDING SUBMISSION OF CONTRACT PERFORMANCE SECURITY
(CPS)/ SECURITY DEPOSIT (SD) WITHIN STIPULATED TIME LINE**

(to be submitted on letter head of bidder)

To,

M/s Talcher Fertilizers Limited

SUB:

TENDER NO:

Dear Sir,

We hereby confirm that we have clearly understood the requirement of Contract Performance Security (CPS) / Security Deposit (SD) specified in the tender document.

We also hereby confirm that in case of award of contract / order, we will submit Contract Performance Security (CPS) / Security Deposit (SD) within 30 days from the date of issuance of Fax of Acceptance.

Place: [Signature of Authorized Signatory of Bidder]

Date: Name:

Designation:

Bidder Name:

Seal:

F-23
PROFORMA FOR CONTRACT AGREEMENT
(To be executed on non-judicial stamp paper of appropriate value)

DLOA No. dated

TFL's PAN No.

Contract Agreement for the work of ----- of TALCHER FERTILIZERS LIMITED made on ---
----- between (Name and Address)-----, hereinafter called the "CONTRACTOR" (which term shall unless excluded by or repugnant to the subject or context include its successors and permitted assignees) of the one part and TALCHER FERTILIZERS LIMITED hereinafter called the "EMPLOYER" (which term shall, unless excluded by or repugnant to the subject or context include its successors and assignees) of the other part.

WHEREAS

- A. The EMPLOYER being desirous of having provided and executed certain work mentioned, enumerated or referred to in the Tender Documents including Letter Inviting Tender, General Tender Notice, General Conditions of Contract, Special Conditions of Contract, Specifications, Drawings, Plans, Time Schedule of completion of jobs, Schedule of Rates, Agreed Variations, other documents has called for Tender.
- B. The CONTRACTOR has inspected the SITE and surroundings of WORK specified in the Tender Documents and has satisfied himself by careful examination before submitting his tender as to the nature of the surface, strata, soil, sub-soil and ground, the form and nature of site and local conditions, the quantities, nature and magnitude of the work, the availability of labour and materials necessary for the execution of work, the means of access to SITE, the supply of power and water thereto and the accommodation he may require and has made local and independent enquiries and obtained complete information as to the matters and thing referred to, or implied in the tender documents or having any connection therewith and has considered the nature and extent of all probable and possible situations, delays, hindrances or interferences to or with the execution and completion of the work to be carried out under the CONTRACT, and has examined and considered all other matters, conditions and things and probable and possible contingencies, and generally all matters incidental thereto and ancillary thereof affecting the execution and completion of the WORK and which might have influenced him in making his tender.
- C. The Tender Documents including the Notice Letter Inviting Tender, General Conditions of Contract, Special Conditions of Contract, Schedule of Rates, General Obligations, SPECIFICATIONS, DRAWINGS, PLANS, Time Schedule for completion of Jobs, Letter of Acceptance of Tender and any statement of agreed variations with its enclosures copies of which are hereto annexed form part of this CONTRACT though separately set out herein and are included in the expression "CONTRACT" wherever herein used.

AND WHEREAS

The EMPLOYER accepted the Tender of the CONTRACTOR for the provision and the execution of the said WORK at the rates stated in the schedule of quantities of the work and finally approved by EMPLOYER (hereinafter called the "Schedule of Rates") upon the terms and subject to the conditions of CONTRACT.

NOW THIS AGREEMENT WITNESSETH AND IT IS HEREBY AGREED AND DECLARED AS FOLLOWS:-

1. In consideration of the payment to be made to the CONTRACTOR for the WORK to be executed by him, the CONTRACTOR hereby covenants with EMPLOYER that the CONTRACTOR shall and will duly provide, execute and complete the said work and shall do and perform all other acts and things in the CONTRACT mentioned or described or which are to be implied there from or may be reasonably necessary for the completion of the said WORK and at the said times and in the manner and subject to the terms and conditions or stipulations mentioned in the contract.
2. In consideration of the due provision execution and completion of the said WORK, EMPLOYER does hereby agree with the CONTRACTOR that the EMPLOYER will pay to the CONTRACTOR the respective amounts for the WORK actually done by him and approved by the EMPLOYER at the Schedule of Rates and such other sum payable to the CONTRACTOR under provision of CONTRACT, such payment to be made at such time in such manner as provided for in the CONTRACT.

A N D

3. In consideration of the due provision, execution and completion of the said WORK the CONTRACTOR does hereby agree to pay such sums as may be due to the EMPLOYER for the services rendered by the EMPLOYER to the CONTRACTOR, such as power supply, water supply and others as set for in the said CONTRACT and such other sums as may become payable to the EMPLOYER towards the controlled items of consumable materials or towards loss, damage to the EMPLOYER'S equipment, materials construction plant and machinery, such payments to be made at such time and in such manner as is provided in the CONTRACT.

It is specifically and distinctly understood and agreed between the EMPLOYER and the CONTRACTOR that the CONTRACTOR shall have no right, title or interest in the SITE made available by the EMPLOYER for execution of the works or in the building, structures or work executed on the said SITE by the CONTRACTOR or in the goods, articles, materials etc., brought on the said SITE (unless the same specifically belongs to the CONTRACTOR) and the CONTRACTOR shall not have or deemed to have any lien whatsoever charge for unpaid bills will not be entitled to assume or retain possession or control of the SITE or structures and the EMPLOYER shall have an absolute and unfettered right to take full possession of SITE and to remove the CONTRACTOR, their servants, agents and materials belonging to the CONTRACTOR and lying on the SITE.

The CONTRACTOR shall be allowed to enter upon the SITE for execution of the WORK only as a licensee simpliciter and shall not have any claim, right, title or interest in the SITE or the structures erected thereon and the EMPLOYER shall be entitled to terminate such license at any time without assigning any reason.

The materials including sand, gravel, stone, loose, earth, rock etc., dug up or excavated from the said SITE shall, unless otherwise expressly agreed under this CONTRACT, exclusively belong to the EMPLOYER and the CONTRACTOR shall have no right to claim over the same and such excavation and materials should be disposed off on account of the EMPLOYER according to the instruction in writing issued from time to time by the ENGINEER-IN-CHARGE.

In Witness whereof the parties have executed these presents in the day and the year first above written.

Signed and Delivered for and on behalf of EMPLOYER

TALCHER FERTILIZERS LIMITED

Signed and Delivered for and on behalf of the CONTRACTOR.

NAME OF CONTRACTOR

Date : _____

Place: _____

IN PRESENCE OF TWO WITNESSES

1. _____

2. _____

Date : _____

Place: _____

1. _____

2. _____

**NO CLAIM CERTIFICATE
(TO BE SUBMITTED BEFORE RELEASE OF CPS/SECURITY DEPOSIT)**

[On the Letter-head of Supplier/Vendor]

We, _____, a company incorporated under the laws of India/ a Consortium between *___ and *___ (*name of Consortium partners to be inserted*)/ a Partnership Firm consisting of *___ and *___ (*name of Partners to be inserted*)/ a Sole Proprietorship (as the case may be), having its registered office at _____ and carrying on business under the name and style M/s. _____ were awarded the contract by TFL. in reference to Tender No. _____ dated _____ (“Order/Contract”).

After completion of the above-said items/job under the Order/Contract, we have scrutinized all our claims, contentions, disputes, issues and we hereby confirm that after adjusting all payments received by us against our R.A. Bills and final bill, we have no claims, dues, issues and contentions from TFL.

We further absolve TFL. from all liabilities present or future arising directly or indirectly out of the Contract.

There is no economic duress or any other compulsion on us for submission of this no claim certificate.

Signature with Seal of Supplier/Vendor

Dated:



PROJECTS & DEVELOPMENT INDIA LIMITED

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General Conditions of Contract

Section- I. Definitions

1. Definition of Terms:

- 1.1 In this CONTRACT (as here-in-after defined) the following words and expressions shall have the meanings hereby assigned to them except where the context otherwise required.
- 1.1.1 The OWNER/EMPLOYER/COMPANY/TFL means Talcher Fertilizers Ltd. (a joint venture of four major Public Sector Units – M/s GAIL (India) Limited, M/s Rastriya Chemicals & Fertilizers Ltd., M/s Coal India Ltd. and M/s Fertilizers Corporation of India Ltd.) and having its Registered office at Plot 2/H, Kalpana Area, BJB Nagar, Khurda, Bhubaneswar-751 014 and includes its successors and assigns.
- 1.1.2 The "CONTRACTOR" means the person or the persons, firm or Company or corporation whose tender has been accepted by the EMPLOYER and includes the CONTRACTOR's legal Representatives his successors and permitted assigns.
- 1.1.3 The ENGINEER/ENGINEER-IN-CHARGE" shall mean the person designated from time to time by the TFL and shall include those who are expressly authorized by him to act for and on his behalf for operation of this CONTRACT.
- 1.1.4 The "WORK" shall mean and include all items and things to be supplied/ done and services and activities to be performed by the CONTRACTOR in pursuant to and in accordance with CONTRACT or part thereof as the case may be and shall include all extra, additional, altered or substituted works as required for purpose of the CONTRACT.
- 1.1.5 The "PERMANENT WORK" means and includes works which will be incorporated in and form a part of the work to be handed over to the EMPLOYER by the CONTRACTOR on completion of the CONTRACT.
- 1.1.6 "CONSTRUCTION EQUIPMENT" means all appliances/equipment and things whatsoever nature for the use in or for the execution, completion, operation, or maintenance of the work or temporary works (as hereinafter defined) but does not include materials or other things intended to form or to be incorporated into the WORK, or camping facilities.
- 1.1.7 "CONTRACT DOCUMENTS" means collectively the Tender Documents, Designs, Drawings, Specification, Schedule of Quantities and Rates, Letter of Acceptance and agreed variations if any, and such other documents constituting the tender and acceptance thereof.
- 1.1.8 CONSULTANT: means Projects & Development India Ltd. (PDIL) who are the consulting engineer to the Employer for this project and having registered office at PDIL Bhawan, A-14, Sector 1, Noida - 201301 (U.P.)
- 1.1.9 The "SUB-CONTRACTOR" means any person or firm or Company (other than the CONTRACTOR) to whom any part of the work has been entrusted by the CONTRACTOR, with the written consent of the ENGINEER-IN-CHARGE, and the legal representatives, successors and permitted assigns of such person, firm or company.
- 1.1.10 The "CONTRACT" shall mean the Agreement between the EMPLOYER



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and the CONTRACTOR for the execution of the works including therein all contract documents.

- 1.1.11 The "SPECIFICATION" shall mean all directions the various technical specifications, provisions attached and referred to the Tender Documents which pertain to the method and manner of performing the work or works to the quantities and qualities of the work or works and the materials to be furnished under the CONTRACT for the work or works, as may be amplified or modified by the TFL or ENGINEER-IN-CHARGE during the performance of CONTRACT in order to provide the unforeseen conditions or in the best interests of the work or works. It shall also include the latest edition of relevant Standard Specifications including all addenda/corrigenda published before entering into CONTRACT.
- 1.1.12 The "DRAWINGS" shall include maps, plans and tracings or prints or sketches thereof with any modifications approved in writing by the ENGINEER-IN-CHARGE and such other drawing as may, from time to time, be furnished or approved in writing by the ENGINEER-IN-CHARGE.
- 1.1.13 The "TENDER" means the proposal along with supporting documents submitted by the CONTRACTOR for consideration by the EMPLOYER.
- 1.1.14 The "CHANGE ORDER" means an order given in writing by the ENGINEER-IN-CHARGE to effect additions to or deletion from and alteration in the works.
- 1.1.15 The "COMPLETION CERTIFICATE" shall mean the certificate to be issued by the ENGINEER-IN-CHARGE when the works have been completed entirely in accordance with CONTRACT DOCUMENT to his satisfaction.
- 1.1.16 The "FINAL CERTIFICATE" in relation to a work means the certificate regarding the satisfactory compliance of various provision of the CONTRACT by the CONTRACTOR issued by the ENGINEER-IN- CHARGE/EMPLOYER after the period of liability is over.
- 1.1.17 "DEFECT LIABILITY PERIOD" in relation to a work means the specified period from the date of COMPLETION CERTIFICATE upto the date of issue of FINAL CERTIFICATE during which the CONTRACTOR stands responsible for rectifying all defects that may appear in the works executed by the CONTRACTOR in pursuance of the CONTRACT and includes warranties against Manufacturing/Fabrication/ Erection/Construction defects covering all materials plants, equipment, components, and the like supplied by the CONTRACTOR, works executed against workmanship defects.
- 1.1.18 The "APPOINTING AUTHORITY" for the purpose of arbitration shall be the CHAIRMAN and MANAGING DIRECTOR or any other person so designated by the EMPLOYER.
- 1.1.19 "TEMPORARY WORKS" shall mean all temporary works of every kind required in or about the execution, completion or maintenance of works.
- 1.1.20 "PLANS" shall mean all maps, sketches and layouts as are incorporated in the CONTRACT in order to define broadly the scope and specifications of the work or works, and all reproductions thereof.
- 1.1.21 "SITE" shall mean the lands and other places on, under, in or through which the permanent works are to be carried out and any other lands or places provided by the EMPLOYER for the purpose of the CONTRACT.
- 1.1.22 "NOTICE IN WRITING OR WRITTEN NOTICE" shall mean a notice in written, typed or printed characters sent (unless delivered personally or otherwise proved to

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have been received by the addressee) by registered post to the latest known private or business address or registered office of the addressee and shall be deemed to have been received in the ordinary course of post it would have been delivered.

- 1.1.23 "APPROVED" shall mean approved in writing including subsequent written confirmation of previous verbal approval and "APPROVAL" means approval in writing including as aforesaid.
- 1.1.24 "LETTER OF INTENT/FAX OF INTENT" shall mean intimation by a Fax/Letter to Tenderer(s) that the tender has been accepted in accordance with the provisions contained in the letter.
- 1.1.25 "DAY" means a day of 24 hours from midnight to midnight irrespective of the number of hours worked in that day.
- 1.1.26 "WORKING DAY" means any day which is not declared to be holiday or rest day by the EMPLOYER.
- 1.1.27 "WEEK" means a period of any consecutive seven days.
- 1.1.28 "METRIC SYSTEM" - All technical documents regarding the construction of works are given in the metric system and all work in the project should be carried out according to the metric system. All documents concerning the work shall also be maintained in the metric system.
- 1.1.29 "VALUE OF CONTRACT" or "TOTAL CONTRACT PRICE" shall mean the sum accepted or the sum calculated in accordance with the prices accepted in tender and/or the CONTRACT rates as payable to the CONTRACTOR for the entire execution and full completion of the work, including change order.
- 1.1.30 "LANGUAGE FOR DRAWINGS AND INSTRUCTION" All the drawings, titles, notes, instruction, dimensions, etc. shall be in English Language.
- 1.1.31 "MOBILIZATION" shall mean establishment of sufficiently adequate infrastructure by the CONTRACTOR at "SITE" comprising of construction equipments, aids, tools tackles including setting of site offices with facilities such as power, water, communication etc. establishing manpower organization comprising of Resident Engineers, Supervising personnel and an adequate strength of skilled, semi-skilled and un-skilled workers, who with the so established infrastructure shall be in a position to commence execution of work at site(s), in accordance with the agreed Time Schedule of Completion of Work. "MOBILISATION" shall be considered to have been achieved, if the CONTRACTOR is able to establish infrastructure as per Time Schedule, where so warranted in accordance with agreed schedule of work implementation to the satisfaction of ENGINEER-IN-CHARGE/ EMPLOYER.
- 1.1.32 "COMMISSIONING" shall mean pressing into service of the system including the plant(s), equipment(s), vessel(s), pipeline, machinery(ies), or any other section or sub-section of installation(s) pertaining to the work of the CONTRACTOR after successful testing and trial runs of the same.
- "COMMISSIONING" can be either for a completed system or a part of system of a combination of systems or sub-systems and can be performed in any sequence as desired by EMPLOYER and in a manner established to be made suited according to availability of pre-requisites. Any such readjustments made by EMPLOYER in performance of "COMMISSIONING" activity will not be construed to be violating CONTRACT provisions and CONTRACTOR shall be deemed to have provided for the same.

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Section-II General Information

2. General Information

2.1 a) Location of Site: The proposed location of Project site is defined in the Special Conditions of Contract.

b) Access by Road: CONTRACTOR, if necessary, shall build other temporary access roads to the actual site of construction for his own work at his own cost. The CONTRACTOR shall be required to permit the use of the roads so constructed by him for vehicles of any other parties who may be engaged on the project site. The CONTRACTOR shall also facilitate the construction of the permanent roads should the construction there of start while he is engaged on this work. He shall make allowance in his tender for any inconvenience he anticipates on such account.

Non-availability of access roads, railway siding and railway wagons for the use of the CONTRACTOR shall in no case condone any delay in the execution of WORK nor be the cause for any claim for compensation against the EMPLOYER.

2.2 Scope of Work: The scope of WORK is defined in the Technical Part of the tender document. The CONTRACTOR shall provide all necessary materials, equipment, labour etc. for the execution and maintenance of the WORK till completion unless otherwise mentioned in the Tender Document.



2.3 Water Supply: Contractor will have to make his own arrangements for supply of water to his labour camps and for works. All pumping installations, pipe net work and distribution system will have to be carried out by the Contractor at his own risk and cost.

Alternatively the Employer at his discretion may endeavour to provide water to the Contractor at the Employer's source of supply provided the Contractor makes his own arrangement for the water meter which shall be in custody of the Employer and other pipe net works from source of supply and such distribution pipe network shall have prior approval of the Engineer-in-Charge so as not to interfere with the layout and progress of the other construction works. In such case, the rate for water shall be deducted from the running account bills.

However, the Employer does not guarantee the supply of water and this does not relieve the Contractor of his responsibility in making his own arrangement and for the timely completion of the various works as stipulated.



2.4 Power Supply:

2.4.1 Subject to availability, EMPLOYER will supply power at 400/440 V at only one point at the nearest sub-station, from where the CONTRACTOR will make his own arrangement for temporary distribution. The point of supply will not be more than 500 m away from the CONTRACTOR'S premises. All the works will be done as per the applicable regulations and passed by the ENGINEER-IN-CHARGE. The temporary line will be removed forthwith after the completion of work or if there is any hindrance caused to the other works due to the alignment of these lines, the CONTRACTOR will re-route or remove the temporary lines at his own cost. The CONTRACTOR at his cost will also provide suitable electric meters, fuses, switches, etc. for purposes of payment to the EMPLOYER which should be in the custody and control of the EMPLOYER. The cost of power supply shall be payable to the EMPLOYER every month for Construction Works power which would be deducted from the running account bills. The EMPLOYER shall not, however, guarantee the supply of electricity nor have any liability in respect thereof. No claim for compensation for any failure or

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short supply of electricity will be admissible.

- 2.4.2 It shall be the responsibility of the CONTRACTOR to provide and maintain the complete installation on the load side of the supply with due regard to safety requirement at site. All cabling, equipment, installations etc. shall comply in all respects with the latest statutory requirements and safety provisions i.e., as per the Central/State Electricity Acts and Rules etc. The CONTRACTOR will ensure that his equipment and Electrical Wiring etc., are installed, modified, maintained by a licensed Electrician/Supervisor. A test certificate is to be produced to the ENGINEER-IN-CHARGE for his approval, before power is made available.
- 2.4.3 At all times, IEA regulations shall be followed failing which the EMPLOYER has a right to disconnect the power supply without any reference to the CONTRACTOR. No claim shall be entertained for such disconnection by the ENGINEER-IN-CHARGE. Power supply will be reconnected only after production of fresh certificate from authorized electrical supervisors.
- 2.4.4 The EMPLOYER is not liable for any loss or damage to the CONTRACTOR's equipment as a result of variation in voltage or frequency or interruption in power supply or other loss to the CONTRACTOR arising therefrom.
- 2.4.5 The CONTRACTOR shall ensure that the Electrical equipment installed by him are such that average power factors does not fall below 0.90 at his premises. In case power factor falls below 0.90 in any month, he will reimburse to the EMPLOYER at the penal rate determined by the EMPLOYER for all units consumed during the month.
- 2.4.6 The power supply required for CONTRACTOR's colony near the plant site will be determined by the EMPLOYER and shall be as per State Electricity Board's Rules and other statutory provisions applicable for such installations from time to time. In case of power supply to CONTRACTOR's colony, the power will be made available at a single point and the CONTRACTOR shall make his own arrangement at his own cost for distribution to the occupants of the colony as per Electricity Rules and Acts. The site and colony shall be sufficiently illuminated to avoid accidents.
- 2.4.7 The CONTRACTOR will have to provide and install his own lights and power meters which will be governed as per Central/State Government Electricity Rules. The meters shall be sealed by the EMPLOYER.
- 2.4.8 In case of damage of any of the EMPLOYER's equipment on account of fault, intentional or unintentional on the part of the CONTRACTOR, the EMPLOYER reserves the right to recover the cost of such damage from the CONTRACTOR's bill. Cost of HRC Fuses replaced at the EMPLOYER's terminals due to any fault in the CONTRACTOR's installation shall be to CONTRACTOR's account at the rates decided by the ENGINEER-IN-CHARGE.
- 2.4.9 Only motors upto 3 HP will be allowed to be started direct on line. For motors above 3 HP and upto 100 HP a suitable Starting device approved by the ENGINEER- IN-CHARGE shall be provided by the CONTRACTOR. For motors above 100 HP slipring induction motors with suitable starting devices as approved by the ENGINEER- IN-CHARGE shall be provided by the CONTRACTOR.
- 2.4.10 The CONTRACTOR shall ensure at his cost that all electrical lines and equipment and all installations are approved by the State Electricity Inspector before power can be supplied to the EMPLOYER.
- 2.4.11 The total requirement of power shall be indicated by the tenderer alongwith his tender.

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2.5 Land for Contractor's Field Office, Godown and Workshop: The EMPLOYER will, at his own discretion and convenience and for the duration of the execution of the work make available near the site, land for construction of CONTRACTOR's Temporary Field Office, godowns workshops and assembly yard required for the execution of the CONTRACT. The CONTRACTOR shall at his own cost construct all these temporary buildings and provide suitable water supply and sanitary arrangement and get the same approved by the ENGINEER-IN-CHARGE.

On completion of the works undertaken by the CONTRACTOR, he shall remove all temporary works erected by him and have the SITE cleaned as directed by ENGINEER-IN-CHARGE. If the CONTRACTOR shall fail to comply with these requirements, the ENGINEER-IN-CHARGE may at he expenses of the CONTRACTOR remove such surplus, and rubbish materials and dispose off the same as he deems fit and get the site cleared as aforesaid; and CONTRACTOR shall forthwith pay the amount of all expenses so incurred and shall have no claim in respect of any such surplus materials disposed off as aforesaid. But the EMPLOYER reserves the right to ask the CONTRACTOR any time during the pendency of the CONTRACT to vacate the land by giving 7 days notice on security reasons or on national interest or otherwise. Rent may be charged for the land so occupied from contractor by the Employer.

The CONTRACTOR shall put up temporary structures as required by them for their office, fabrication shop and construction stores only in the area allocated to them on the project site by the EMPLOYER or his authorized representative. No tea stalls/canteens should be put up or allowed to be put up by any CONTRACTOR in the allotted land or complex area without written permission of the EMPLOYER.

No unauthorized buildings, constructions or structures should be put up by the CONTRACTOR anywhere on the project site.

For uninterrupted fabrication work, the CONTRACTOR shall put up temporary covered structures at his cost within Area in the location allocated to them in the project site by the EMPLOYER or his authorized representative.

No person except for authorized watchman shall be allowed to stay in the plant area/CONTRACTOR's area after completion of the day's job without prior written permission from ENGINEER-IN-CHARGE.

2.6 Land for Residential Accommodation:-:No Land shall be made available for residential accommodation for staff and labour of CONTRACTOR.

Section-III. General Instructions to Tenderers

3. Submission of Tender:

- 3.1 TENDER must be submitted without making any additions, alterations, and as per details given in other clauses hereunder. The requisite details shall be filled in by the TENDERER at space provided under "Submission of Tender" at the beginning of GCC of Tender Document. The rate shall be filled only in the schedule given in this Tender Document.
- 3.2 Addenda/ Corrigenda to this Tender Document, if issued, must be signed, submitted along with the Tender Document. the tenderer should write clearly the revised quantities in Schedule of Rates of Tender Document and should price the WORK based on revised quantities when amendments of quantities are issued in addenda.
- 3.3 Covering letter along with its enclosures accompanying the Tender Document and all further correspondence shall be submitted in duplicate.
- 3.4 Tenderers are advised to submit quotations based strictly on the terms and conditions and specifications contained in the Tender Documents and not to stipulate any deviations.



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3.5 ~~Tenders should always be placed in double sealed covers, super scribing ["QUOTATION DO NOT OPEN" Tender for _____ Project of Talcher Fertilizers Ltd. due for opening on _____]. The Full Name, Address and Telegraphic Address, Fax No. of the Tenderers shall be written on the bottom left hand corner of the sealed cover.~~

4. Documents:

4.1 General:

The tenders as submitted, will consist of the following:

- i) Complete set of Tender Documents (Original) as sold duly filled in and signed by the tenderer as prescribed in different clauses of the Tender Documents.
- ii) Earnest money in the manner specified in Clause 6 hereof.
- iii) Power of Attorney or a true copy thereof duly attested by a Gazetted Officer in case an authorized representative has signed the tender, as required by Clause 14 hereof.
- iv) Information regarding tenderers in the proforma enclosed.
- v) Details of work of similar type and magnitude carried out by the Tenderer in the proforma provided in the tender document.
- vi) Organization chart giving details of field management at site, the tenderer proposes to have for this job.
- vii) Details of construction plant and equipments available with the tenderer for using in this work.
- viii) Solvency Certificate from Scheduled Bank to prove the financial ability to carry out the work tendered for.
- ix) Latest Balance Sheet and Profit & Loss Account duly audited.
- x) Details of present commitment as per proforma enclosed to tender.
- xi) Data required regarding SUB-CONTRACTOR(s)/ Supplier/ Manufacturers and other technical information the tenderer wish to furnish.
- xii) Provident fund registration certificate
- xiii) List showing all enclosures to tender.

4.2 All pages are to be Initiated: All signatures in Tender Documents shall be dated, as well as, all the pages of all sections of Tender Documents shall be initialed at the lower right hand corner and signed wherever required in the tender papers by the TENDERER or by a person holding power of attorney authorizing him to sign on behalf of the tenderer before submission of tender.

4.3 Rates to be in Figures and Words: The tender should quote in English both in figures as well as in words the rates and amounts tendered by him in the Schedule of Rates of Tender submitted by the CONTRACTOR for each item and in such a way that interpolation is not possible. The amount for each item should be worked out and entered and requisite total given of all items, both in figures and in words. The tendered amount for the work shall be entered in the tender and duly signed by the Tenderer.

If some discrepancies are found between the RATES in FIGURES and WORDS or the AMOUNT shown in the tender, the following procedure shall be followed:



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- a) When there is difference between the rates in figures and words, the rate which corresponds to the amount worked out by the tenderer shall be taken as correct.
- b) When the rate quoted by the tenderer in figures and words tally but the amount is incorrect the rate quoted by the tenderer shall be taken as correct.
- c) When it is not possible to ascertain the correct rate by either of above methods, the rate quoted in words shall be taken as correct.

4.4 Corrections and Erasures: All correction(s) and alteration(s) in the entries of tender paper shall be signed in full by the TENDERER with date. No erasure or over writing is permissible.

4.5 Signature of Tenderer:

4.5.1 The TENDERER shall contain the name, residence and place of business of person or persons making the tender and shall be signed by the TENDERER with his usual signature. Partnership firms shall furnish the full names of all partners in the tender. It should be signed in the partnership's name by all the partners or by duly authorized representatives followed by the name and designation of the person signing. Tender by a corporation shall be signed by an authorized representative, and a Power of Attorney in that behalf shall accompany the tender. A copy of the constitution of the firm with names of all partners shall be furnished.

4.5.2 When a tenderer signs a tender in a language other than English, the total amount tendered should, in addition, be written in the same language. The signature should be attested by at least one witness.

4.6 Witness: Witness and sureties shall be persons of status and property and their names, occupation and address shall be stated below their signature.

4.7 Details of Experience: The tenderer should furnish, along with his tender, details of previous experience in having successfully completed in the recent past works of this nature, together with the names of Employers, location of sites and value of contract, date of commencement and completion of work, delays if any, reasons of delay and other details along with documentary evidence(s).

4.8 Liability of Government of India: It is expressly understood and agreed by and between Bidder or/Contractor and M/s Talcher Fertilizers Ltd., and that M/s Talcher Fertilizers Ltd., is entering into this agreement solely on its own behalf and not on behalf of any other person or entity. In particular, it is expressly understood and agreed that the Government of India is not a party to this agreement and has no liabilities, obligations or rights hereunder. It is expressly understood and agreed that M/s Talcher Fertilizers Ltd. is an independent legal entity with power and authority to enter into contracts solely on its own behalf under the applicable Laws of India and general principles of Contract Law. The Bidder/Contractor expressly agrees, acknowledges and understands that M/s Talcher Fertilizers Ltd. is not an agent, representative or delegate of the Government of India. It is further understood and agreed that the Government of India is not and shall not be liable for any acts, omissions, commissions, breaches or other wrongs arising out of the contract. Accordingly, Bidder/Contractor hereby expressly waives, releases and foregoes any and all actions or claims, including cross claims, impleader claims or counter claims against the Government of India arising out of this contract and covenants not to sue to Government of India as to any manner, claim, cause of action or thing whatsoever arising of or under this agreement.

5. Transfer of Tender Documents:

5.1 Transfer of Tender Documents purchased by one intending tenderer to another is not permissible.



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- 6. Earnest Money:**
(Clause not applicable for this Tender)
- 6.1 The bidder must pay Earnest Money as given in the letter /notice inviting tenders and attach the official receipt with the tender failing which the tender is liable to be rejected and representatives of such tenderers will not be allowed to attend the tender opening. Earnest Money can be paid in Demand Drafts or Bank Guarantee or Banker's Cheque or Letter of Credit from any Indian scheduled bank or a branch of an International bank situated in India and registered with Reserve Bank of India as scheduled foreign bank. However, other than the Nationalized Indian Banks, the banks whose BGs are furnished, must be commercial banks having net worth in excess of Rs. 100 crores and a declaration to this effect should be made by such commercial bank either in the bank guarantee itself or separately on a letter head.
- The bid guarantee shall be submitted in the prescribed format.
- Note: The Bank Guarantee so furnished by the tenderer shall be in the proforma prescribed by the EMPLOYER. No interest shall be paid by the EMPLOYER on the Earnest Money deposited by the tenderer. The Bank Guarantee furnished in lieu of Earnest Money shall be kept valid for a period of "SIX MONTHS" from the date of opening of tender.(TWO MONTHS beyond the bid due date).
- The Earnest Money deposited by successful tenderer shall be forfeited if the Contractor fails to furnish the requisite Contract Performance Security as per clause 24 hereof and /or fails to start work within a period of 15 days or fails to execute the AGREEMENT within 15 days of the receipt by him of the Notification of Acceptance of Tender.
- Note: The Earnest Money of the unsuccessful bidder will be returned by EMPLOYER/CONSULTANT, directly to the tenderer(s), within a reasonable period of time but not later than 30 days after the expiration of the period of bid validity prescribed by EMPLOYER.
- 7 Validity:**
- 7.1 Tender submitted by tenderers shall remain valid for acceptance for a period of "4 MONTHS" from the date of opening of the tender. The tenderers shall not be entitled during the said period of 4 months, without the consent in writing of the EMPLOYER, to revoke or cancel his tender or to vary the tender given or any term thereof. In case of tender revoking or canceling his tender or varying any term in regard thereof without the consent of EMPLOYER in writing, the EMPLOYER shall forfeit Earnest Money paid by him alongwith tender.
- 8 Addenda/Corrigenda**
- 8.1 Addenda/ Corrigenda to the Tender Documents will be issued in duplicate prior to the date of opening of the tenders to clarify documents or to reflect modification in design or CONTRACT terms.
- 8.2 Each addenda/ corrigendum issued will be issued in duplicate to each person or organization to whom set of Tender Documents has been issued. Recipient will retain tenderer's copy of each Addendum/ Corrigendum and attach original copy duly signed along with his offer. All Addenda/ Corrigenda issued shall become part of Tender Documents.
- 9 Right of Employer to Accept or Reject Tender:**
- 9.1 The right to accept the tender will rest with the EMPLOYER. The EMPLOYER, however, does not bind himself to accept the lowest tender, and reserves to itself the authority to reject any or all the tenders received without assigning any reason whatsoever. At the option of the Employer, the work for which the tender had been invited, may be awarded to one Contractor or split between more than one bidders, in which case the award will be made for only that part of the work, in respect of which the bid has been accepted. The quoted rates should hold good for such eventualities.

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Tenders in which any of the particulars and prescribed information are missing or are incomplete in any respect and/or the prescribed conditions are not fulfilled are liable to be rejected. The Tender containing uncalled for remarks or any additional conditions are liable to be rejected.

Canvassing in connection with tenders is strictly prohibited and tenders submitted by the Tenderers who resort to canvassing will be liable to rejection.

10 Time Schedule

- 10.1 The WORK shall be executed strictly as per the TIME SCHEDULE specified in TENDER/ CONTRACT Document. The period of construction given in Time Schedule includes the time required for mobilization as well as testing, rectifications if any, retesting and completion in all respects to the entire satisfaction of the ENGINEER-IN- CHARGE.
- 10.2 A joint program of execution of the WORK will be prepared by the ENGINEER-IN-CHARGE and CONTRACTOR based on priority requirement of this project. This program will take into account the time of completion mentioned in 10.1 above and the time allowed for the priority works by the ENGINEER-IN-CHARGE.
- 10.3 Monthly/ Weekly construction program will; be drawn up by the ENGINEER-IN-CHARGE jointly with the CONTRACTOR, based on availability of work fronts and the joint construction program as per 10.2 above. The CONTRACTOR shall scrupulously adhere to these targets/ programs by deploying adequate personnel, construction tools and tackles and he shall also supply himself all materials of his scope of supply in good time to achieve the targets/program. In all matters concerning the extent of targets set out in the weekly and monthly programs and the degree of achievements the decision of the ENGINEER-IN-CHARGE will be final and binding on the CONTRACTOR.

11 Tenderer's Responsibility

- 11.1 The intending tenderers shall be deemed to have visited the SITE and familiarized submitting the tender. Non-familiarity with the site conditions will not be considered a reason either for extra claims or for not carrying out the works in strict conformity with the DRAWINGS and SPECIFICATIONS or for any delay in performance.

12 Retired Government or Company Officers



- 12.1 No Engineer of Gazetted rank or other Gazetted Officer employed in Engineering or Administrative duties in an Engineering Department of the States/ Central Government or of the EMPLOYER is allowed to work as a CONTRACTOR for a period of two years after his retirement from Government Service, or from the employment of the EMPLOYER without the previous permission of the EMPLOYER. The CONTRACT, if awarded, is liable to be cancelled if either the CONTRACTOR or any of his employees is found at any time to be such a person, who has not obtained the permission of the State/ Central Government or of the EMPLOYER as aforesaid before submission of tender, or engagement in the CONTRACTOR'S service as the case may be.

13 Signing of the Contract:

- 13.1 The successful tenderer shall be required to execute an AGREEMENT in the proforma attached with TENDER DOCUMENT within 15 days of the receipt by him of the Notification of Acceptance of Tender. In the event of failure on the part of the successful tenderer to sign the AGREEMENT within the above stipulated period, the Earnest Money or his initial deposit will be forfeited and the acceptance of the tender shall be considered as cancelled.



14 Field Management & Controlling/Coordinating Authority:

- 14.1 The field management will be the responsibility of the ENGINEER-IN-CHARGE, who will be nominated by the EMPLOYER. The ENGINEER-IN-CHARGE may also authorize his representatives to assist in performing his duties and functions.
- 14.2 The ENGINEER-IN-CHARGE shall coordinate the works of various agencies engaged at site to ensure minimum disruption of work carried out by different

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agencies. It shall be the responsibility of the CONTRACTOR to plan and execute the work strictly in accordance with site instructions to avoid hindrance to the work being executed by other agencies.

- 15 Note to Schedule of Rates:**
- 15.1 The Schedule of Rates should be read in conjunction with all the other sections of the tender.
- 15.2 The tenderer shall be deemed to have studied the DRAWINGS, SPECIFICATIONS and details of work to be done within TIME SCHEDULE and to have acquainted himself of the condition prevailing at site.
- 15.3 Rates must be filled in the Schedule of Rates of original Tender Documents. If quoted in separate typed sheets no variation in item description or specification shall be accepted. Any exceptions taken by the tenderer to the Schedule of Rates shall be brought out in the terms and conditions of the offer.
- 15.4 The quantities shown against the various items are only approximate. Any increase or decrease in the quantities shall not form the basis of alteration of the rates quoted and accepted.
- 15.5 The EMPLOYER reserves the right to interpolate the rates for such items of work falling between similar items of lower and higher magnitude.
- 16 Policy for Tenders Under Consideration:**
- 16.1 Only Those Tenders which are complete in all respects and are strictly in accordance with the Terms and Conditions and Technical Specifications of Tender Document, shall be considered for evaluation. Such Tenders shall be deemed to be under consideration immediately after opening of Tender and until such time an official intimation of acceptance/ rejection of Tender is made by TFL to the Bidder.
- 16.2 Zero Deviation: Bidders to note that this is a ZERO DEVIATION TENDER. TFL will appreciate submission of offer based on the terms and conditions in the enclosed General Conditions of Contract (GCC), Special Conditions of Contract (SCC), Instructions to Bidders (ITB), Scope of Work, technical specifications etc. to avoid wastage of time and money in seeking clarifications on technical/commercial aspects of the offer. Bidder may note that no technical and commercial clarifications will be sought for after the receipt of the bids. In case of any deviation/ nonconformity observed in the bid, it will be liable for rejection.
- 17 Award of Contract:**
- 17.1 The Acceptance of Tender will be intimated to the successful Tenderer by TFL either by Telex/ Telegram/ Fax or by Letter or like means-defined as LETTER OF ACCEPTANCE OF TENDER.
- 17.2 TFL will be the sole judge in the matter of award of CONTRACT and the decision of TFL shall be final and binding.
- 18 Clarification of Tender Document:**
- 18.1 The Tender is required to carefully examine the Technical Specifications, Conditions of Contract, Drawings and other details relating to WORK and given in Tender Document and fully inform himself as to all conditions and matters which may in any way affect the WORK or the cost thereof. In case the Tenderer is in doubt about the completeness or correctness of any of the contents of the Tender Documents he should request in writing for an interpretation/ clarification to TFL in triplicate. TFL will then issue interpretation/ clarification to Tenderer in writing. Such clarifications and or interpretations shall form part of the Specifications and Documents and shall accompany the tender which shall be submitted by tenderer within time and date as specified in invitations to tender.
- 18.2 Verbal clarification and information given by TFL or its employee(s) or its representatives shall not in any way be binding on TFL.

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- 19 Local Conditions:**
- 19.1 It will be imperative on each tenderer to inform himself of all local conditions and factors which may have any effect on the execution of WORK covered under the Tender Document. In their own interest, the tenderer are requested to familiarize themselves with the Indian Income Tax Act 1961, Indian Companies Act 1956, Indian Customs Act 1962 and other related Acts and Laws and Regulations of India with their latest amendments, as applicable TFL shall not entertain any requests for clarifications from the tenderer regarding such local conditions.
- 19.2 It must be understood and agreed that such factors have properly been investigated and considered while submitting the tender. No claim for financial or any other adjustments to VALUE OF CONTRACT, on lack of clarity of such factors shall be entertained.
- 20 Abnormal Rates:**
- 20.1 The tenderer is expected to quote rate for each item after careful analysis of cost involved for the performance of the completed item considering all specifications and Conditions of Contract. This will avoid loss of profit or gain in case of curtailment or change of specification for any item. In case it is noticed that the rates quoted by the tenderer for any item are unusually high or unusually low, it will be sufficient cause for the rejection of the tender unless the EMPLOYER is convinced about the reasonableness after scrutiny of the analysis for such rate(s) to be furnished by the tenderer (on demand).

Section-IV. General Obligations

- 21 Priority of Contract Documents**
- 21.1 Except if and the extent otherwise provided by the Contract, the provisions of the General Conditions of Contract and Special Conditions shall prevail over those of any other documents forming part of the CONTRACT. Several documents forming the CONTRACT are to be taken as mutually explanatory of one another, but in case of ambiguities or discrepancies the same shall be explained and adjusted by the ENGINEER-IN-CHARGE who shall thereupon issue to the Contractor instructions thereon and in such event, unless otherwise provided in the Contract, the priority of the documents forming the Contract shall be as follows :
- 1) The Contract Agreement ;
 - 2) The Letter of Acceptance;
 - 3) The Instructions to Bidders (ITB);
 - 4) Special Conditions of Contract (SCC);
 - 5) General Conditions of Contract (GCC)
 - 6) Any other document forming part of the Contract.
- Works shown in the DRAWING but not mentioned in the SPECIFICATIONS OR described in the SPECIFICATIONS without being shown in the DRAWINGS shall nevertheless be deemed to be included in the same manner as if they had been specifically shown upon the DRAWINGS and described in the SPECIFICATIONS.
- 21.2 Headings and Marginal Notes: All headings and marginal notes to the clauses of these General Conditions of Contract or to the SPECIFICATIONS or to any other Tender Document are solely for the purpose of giving a concise indication and not a summary of the contents thereof, and they shall never be deemed to be part thereof or be used in the interpretation or construction thereof the CONTRACT.
- 21.3 Singular and Plural: In CONTRACT DOCUMENTS unless otherwise stated specifically, the singular shall include the plural and vice versa wherever the context so requires.
- 21.4 Interpretation: Words implying 'Persons' shall include relevant 'Corporate Companies / Registered Associations/ Body of Individuals/ Firm of Partnership' as the case may be.



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22 Special Conditions of Contract:



- 22.1 Special Conditions of Contract shall be read in conjunction with the General Conditions of Contract, specification of Work, Drawings and any other documents forming part of this CONTRACT wherever the context so requires.
- 22.2 Notwithstanding the sub-division of the documents into these separate sections and volumes every part of each shall be deemed to be supplementary to and complementary of every other part and shall be read with and into the CONTRACT so far as it may be practicable to do so.
- 22.3 Where any portion of the General Condition of Contract is repugnant to or at variance with any provisions of the Special Conditions of Contract, unless a different intention appears the provisions of the Special Conditions of Contract shall be deemed to over-ride the provisions of the General Conditions of Contract and shall to the extent of such repugnancy, or variations, prevail.
- 22.4 Wherever it is mentioned in the specifications that the CONTRACTOR shall perform certain WORK or provide certain facilities, it is understood that the CONTRACTOR shall do so at his cost and the VALUE OF CONTRACT shall be deemed to have included cost of such performance and provisions, so mentioned.
- 22.5 The materials, design and workmanship shall satisfy the relevant INDIAN STANDARDS, the JOB SPECIFICATIONS contained herein and CODES referred to. Where the job specification stipulate requirements in addition to those contained in the standard codes and specifications, these additional requirements shall also be satisfied.

23 Contractor to obtain his own Information:

- 23.1 The CONTRACTOR in fixing his rate shall for all purpose whatsoever reason may be, deemed to have himself independently obtained all necessary information for the purpose of preparing his tender and his tender as accepted shall be deemed to have taken into account all contingencies as may arise due to such information or lack of same. The correctness of the details, given in the Tender Document to help the CONTRACTOR to make up the tender is not guaranteed.

The CONTRACTOR shall be deemed to have examined the CONTRACT DOCUMENTS, to have generally obtained his own information in all matters whatsoever that might affect the carrying out of the works at the schedules rates and to have satisfied himself to the sufficiency of his tender. Any error in description of quantity or omission there from shall not vitiate the CONTRACT or release the CONTRACTOR from executing the work comprised in the CONTRACT according to DRAWINGS and SPECIFICATIONS at the scheduled rates. He is deemed to have known the scope, nature and magnitude of the WORKS and the requirements of materials and labour involved etc., and as to what all works he has to complete in accordance with the CONTRACT documents whatever be the defects, omissions or errors that may be found in the DOCUMENTS. The CONTRACTOR shall be deemed to have visited surroundings, to have satisfied himself to the nature of all existing structures, if any, and also as to the nature and the conditions of the Railways, Roads, Bridges and Culverts, means of transport and communication, whether by land, water or air, and as to possible interruptions thereto and the access and egress from the site, to have made enquiries, examined and satisfied himself as to the sites for obtaining sand, stones, bricks and other materials, the sites for disposal of surplus materials, the available accommodation as to whatever required, depots and such other buildings as may be necessary for executing and completing the works, to have made local independent enquiries as to the sub-soil, subsoil water and variations thereof, storms, prevailing winds, climatic conditions and all other similar matters effecting these works. He is deemed to have acquainted himself as to his liability of payment of Government Taxes, Customs duty and other charges, levies etc.

Any neglect or omission or failure on the part of the CONTRACTOR in obtaining

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necessary and reliable information upon the foregoing or any other matters affecting the CONTRACT shall not relieve him from any risks or liabilities or the entire responsibility from completion of the works at the scheduled rates and times in strict accordance with the CONTRACT.



It is, therefore, expected that should the CONTRACTOR have any doubt as to the meaning of any portion of the CONTRACT DOCUMENT he shall set forth the particulars thereof in writing to EMPLOYER in duplicate, before submission of tender. The EMPLOYER may provide such clarification as may be necessary in writing to CONTRACT, such clarifications as provided by EMPLOYER shall form part of CONTRACT DOCUMENTS.

No verbal agreement or inference from conversation with any effect or employee of the EMPLOYER either before, during or after the execution of the CONTRACT agreement shall in any way affect or modify and of the terms or obligations herein contained.

Any change in layout due to site conditions or technological requirement shall be binding on the CONTRACTOR and no extra claim on this account shall be entertained.

24 Contract Performance Security:

- 24.1 The CONTRACTOR shall furnish to the EMPLOYER, within 30 days from the date of notification of award, a security in the sum of 10% of the accepted value of the tender or the actual value of work to be done whichever is applicable due to any additional work or any other reasons, in the form of a Bank draft/Banker's cheque or Bank Guarantee or irrevocable Letter of credit (as per proforma enclosed) as Contract Performance Security with the EMPLOYER which will be refunded after the expiry of DEFECTS LIABILITY PERIOD.
- 24.2 CONTRACTOR can furnish the Contract Performance Security in the form of Demand Draft or through a Bank Guarantee or through an irrevocable Letter of Credit from any Indian scheduled bank or a branch of an International bank situated in India and registered with Reserve Bank of India as scheduled foreign bank. However, other than the Nationalized Indian Banks, the banks whose BGs are furnished, must be commercial banks having net worth in excess of Rs. 100 crores and a declaration to this effect should be made by such commercial bank either in the bank guarantee itself or separately on a letter head.
- The bank guarantee or the Letter of Credit shall be submitted in the prescribed format.
- 24.3 If the CONTRACTOR/SUB-CONTRACTOR or their employees or the CONTRACTOR's agents and representatives shall damage, break, deface or destroy any property belonging to the EMPLOYER or others during the execution of the CONTRACT, the same shall be made good by the CONTRACTOR at his own expenses and in default thereof, the ENGINEER-IN-CHARGE may cause the same to be made good by other agencies and recover expenses from the CONTRACTOR (for which the certificate of the ENGINEER- IN-CHARGE shall be final).
- 24.4 All compensation or other sums of money payable by the CONTRACTOR to the EMPLOYER under terms of this CONTRACT may be deducted from or paid by the encashment or sale of a sufficient part of his Contract Performance Security or from any sums which may be due or may become due to the CONTRACTOR by the EMPLOYER of any account whatsoever and in the event of his Contract Performance Security being reduced by reasons of any such deductions or sale of aforesaid, the CONTRACTOR shall within ten days thereafter make good in cash, bank drafts as aforesaid any sum or sums which may have been deducted from or realized by sale of his Contract Performance Security, or any part thereof. No interest shall be payable by the EMPLOYER for sum deposited as Contract

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- 24.5 Failure of the successful bidder to comply with the requirements of this Clause shall constitute sufficient grounds for the annulment of the award and the forfeiture of bid security.

25 Time of Performance:

25.1 Time for Mobilization

The work covered by this CONTRACT shall be commenced within fifteen (15) days, the date of letter/Fax of Intent and be completed in stages on or before the dates as mentioned in the TIME SCHEDULE OF COMPLETION OF WORK. The CONTRACTOR should bear in mind that time is the essence of this agreement. Request for revision of construction time after tenders are opened will not receive consideration. The above period of fifteen (15) days is included within the overall COMPLETION SCHEDULE, not over and above the completion time to any additional work or any other reasons.

25.2 Time Schedule of Construction:

25.2.1 The general Time Schedule of construction is given in the TENDER DOCUMENT. CONTRACTOR should prepare a detailed monthly or weekly construction program jointly with the ENGINEER-IN-CHARGE within 15 days of receipt of LETTER/FAX OF INTENT or ACCEPTANCE OF TENDER. The WORK shall be executed strictly as per the Time Schedule given in the CONTRACT DOCUMENT. The period of construction given includes the time required for mobilization testing, rectifications, if any, retesting and completion in all respects in accordance with CONTRACT DOCUMENT to the entire satisfaction of the ENGINEER-IN-CHARGE.

25.2.2 The CONTRACTOR shall submit a detailed PERT network within the time frame agreed above consisting of adequate number of activities covering various key phases of the WORK such as design, procurement, manufacturing, shipment and field erection activities within fifteen (15) days from the date of LETTER/FAX OF INTENT. This network shall also indicate the interface facilities to be provided by the EMPLOYER and the dates by which such facilities are needed.

25.2.3 CONTRACTOR shall discuss the network so submitted with the EMPLOYER and the agreed network which may be in the form as submitted with the EMPLOYER or in revised form in line with the outcome of discussions shall form part of the CONTRACT, to be signed within fifteen (15) days from the date of LETTER OF ACCEPTANCE OF TENDER. During the performance of the CONTRACT, if in the opinion of the EMPLOYER proper progress is not maintained suitable changes shall be made in the CONTRACTOR's operation to ensure proper progress.



The above PERT network shall be reviewed periodically and reports shall be submitted by the CONTRACTOR as directed by EMPLOYER.

26 Force Majeure:

26.1 CONDITIONS FOR FORCE MAJEURES

In the event of either party being rendered unable by Force Majeure to perform any obligations required to be performed by them under the CONTRACT the relative obligation of the party affected by such Force Majeures shall upon notification to the other party be suspended for the period during which Force Majeures event lasts. The cost and loss sustained by the either party shall be borne by the respective parties.

The term "Force Majeures" as employed herein shall mean acts of God, earthquake, war (declared or undeclared), revolts, riots, fires, floods, rebellions, explosions, hurricane, sabotage, civil commotions and acts and regulations of respective Government of the two parties, namely the EMPLOYER and the

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Upon the occurrence of such cause(s) and upon its termination, the party alleging that it has been rendered unable as aforesaid thereby, shall notify the other party in writing immediately but not later than 72 (Seventy-two) hours of the alleged beginning and ending thereof giving full particulars and satisfactory evidence in support of its claim.

Time for performance of the relative obligation suspended by the Force Majeures shall then stand extended by the period for which such cause lasts.

If deliveries of bought out items and/or works to be executed by the CONTRACTOR are suspended by Force Majeure conditions lasting for more than 2 (two) months the EMPLOYER shall have the option to terminate the CONTRACT or re-negotiate the contract provisions.

26.2 OUTBREAK OF WAR

26.2.1 If during the currency of the CONTRACT there shall be an out-break of war whether declared or not, in that part of the World which whether financially or otherwise materially affect the execution of the WORK the CONTRACTOR shall unless and until the CONTRACT is terminated under the provisions in this clause continue to use his best Endeavour to complete the execution of the WORK, provided always that the EMPLOYER shall be entitled, at any time after such out-break of war to terminate or re-negotiate the CONTRACT by giving notice in writing to the CONTRACTOR and upon such notice being given the CONTRACT shall, save as to the rights of the parties under this clause and to the operation of the clauses entitled settlement of Disputes and Arbitration hereof, be terminated but without prejudice to the right of either party in respect of any antecedent breach thereof.

26.2.2 If the CONTRACT shall be terminated under the provisions of the above clause, the CONTRACTOR shall with all reasonable diligence remove from the SITE all the CONTRACTOR's equipment and shall give similar facilities to his SUB-CONTRACTORS to do so.

27 **Price reduction schedule:**

27.1 Time is the essence of the CONTRACT. In case the CONTRACTOR fails to complete the WORK within the stipulated period, then, unless such failure is due to Force Majeure as defined in Clause 26 here above or due to EMPLOYER's defaults, the Total Contract price shall be reduced by ½ % of the total Contract Price per complete week of delay or part thereof subject to a maximum of 5 % of the Total Contract Price, by way of reduction in price for delay and not as penalty. The said amount will be recovered from amount due to the Contractor/ Contractor's Contract Performance Security payable on demand.

The decision of the OWNER in regard to applicability of Price Reduction Schedule shall be final and binding on the CONTRACTOR.

27.2 All sums payable under this clause is the reduction in price due to delay in completion period at the above agreed rate.



27.3 BONUS FOR EARLY COMPLETION

Bonus For Early Completion 27.3 (*)

**(Clause not applicable for this
Tender)**

If the Contractor achieves completion of Works in all respect prior to the time schedule stipulated in the SCC, the Employer shall pay to the Contractor the relevant sum, if mentioned specifically in SCC, as bonus for early completion. The bonus for early completion, if provided specifically in SCC, shall be payable to the maximum ceiling of 2 ½ % of the total contract price.

(*) Partial earlier completion may not always produce net benefits to the Employer,

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for example where utilization of the completed Works requires (a) the fulfillment of all parts of the Contract (e.g. the training of personnel); or (b) the completion of all Sections (e.g. in pipeline laying, where early completion of the laying of pipeline would not be useful if the compressor is still under installation); or (c) certain seasonal effects to take place (e.g. onset of the rainy season, for impounding a reservoir); or (d) other circumstances. Also a more rapid drawdown of budgeted funds may be required. All such factors should be considered prior to the inclusion of a bonus clause in the Contract.

28 Rights of the employer to forfeit contract performance security:

- 28.1 Whenever any claim against the CONTRACTOR for the payment of a sum of money arises out or under the CONTRACT, the EMPLOYER shall be entitled to recover such sum by appropriating in part or whole the Contract Performance Security of the CONTRACTOR. In the event of the security being insufficient or if no security has been taken from the CONTRACTOR, then the balance or the total sum recoverable, as the case may be shall be deducted from any sum then due or which at any time thereafter may become due to the CONTRACTOR. The CONTRACTOR shall pay to the EMPLOYER on demand any balance remaining due.
- 28.2 In .case of forfeiture of Contract Performance Security/ Security Deposit, the forfeited amount will be considered inclusive of tax and tax invoice will be issued by TFL. The forfeiture amount will be subject to final decision of TFL based on other terms and conditions of order/ contract.

29 Failure by the contractor to comply with the provisions of the contract:

- 29.1 If the CONTRACTOR refuses or fails to execute the WORK or any separate part thereof with such diligence as will ensure its completion within the time specified in the CONTRACT or extension thereof or fails to perform any of his obligation under the CONTRACT or in any manner commits a breach of any of the provisions of the CONTRACT it shall be open to the EMPLOYER at its option by written notice to the CONTRACTOR:

a) TO DETERMINE THE CONTRACT in which event the CONTRACT shall stand terminated and shall cease to be in force and effect on and from the date appointed by the EMPLOYER on that behalf, whereupon the CONTRACTOR shall stop forthwith any of the CONTRACTOR's work then in progress, except such WORK as the EMPLOYER may, in writing, require to be done to safeguard any property or WORK, or installations from damage, and the EMPLOYER, for its part, may take over the work remaining unfinished by the CONTRACTOR and complete the same through a fresh contractor or by other means, at the risk and cost of the CONTRACTOR, and any of his sureties if any, shall be liable to the EMPLOYER for any excess cost occasioned by such work having to be so taken over and completed by the EMPLOYER over and above the cost at the rates specified in the schedule of quantities and rate/prices.

b) WITHOUT DETERMINING THE CONTRACT to take over the work of the CONTRACTOR or any part thereof and complete the same through a fresh contractor or by other means at the risk and cost of the CONTRACTOR. The CONTRACTOR and any of his sureties are liable to the EMPLOYER for any excess cost over and above the cost at the rates specified in the Schedule of Quantities/ rates, occasioned by such works having been taken over and completed by the EMPLOYER.

- 29.2 In such events of Clause 29.1(a) or (b) above.

a) The whole or part of the Contract Performance Security furnished by the CONTRACTOR is liable to be forfeited without prejudice to the right of the EMPLOYER to recover from the



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CONTRACTOR the excess cost referred to in the sub-clause aforesaid, the EMPLOYER shall also have the right of taking possession and utilizing in completing the works or any part thereof, such as materials equipment and plants available at work site belonging to the CONTRACTOR as may be necessary and the CONTRACTOR shall not be entitled for any compensation for use or damage to such materials, equipment and plant.

b) The amount that may have become due to the CONTRACTOR on account of work already executed by him shall not be payable to him until after the expiry of Six (6) calendar months reckoned from the date of termination of CONTRACT or from the taking over of the WORK or part thereof by the EMPLOYER as the case may be, during which period the responsibility for faulty materials or workmanship in respect of such work shall, under the CONTRACT, rest exclusively with the CONTRACTOR. This amount shall be subject to deduction of any amounts due from the CONTRACT to the EMPLOYER under the terms of the CONTRACT authorized or required to be reserved or retained by the EMPLOYER.



29.3 Before determining the CONTRACT as per Clause 29.1(a) or (b) provided in the judgment of the EMPLOYER, the default or defaults committed by the CONTRACTOR is/are curable and can be cured by the CONTRACTOR if an opportunity given to him, then the EMPLOYER may issue Notice in writing calling the CONTRACTOR to cure the default within such time specified in the Notice.

29.4 The EMPLOYER shall also have the right to proceed or take action as per 29.1(a) or (b) above, in the event that the CONTRACTOR becomes bankrupt, insolvent, compounds with his creditors, assigns the CONTRACT in favour of his creditors or any other person or persons, or being a company or a corporation goes into voluntary liquidation, provided that in the said events it shall not be necessary for the EMPLOYER to give any prior notice to the CONTRACTOR.

29.5 Termination of the CONTRACT as provided for in sub- clause 29.1(a) above shall not prejudice or affect their rights of the EMPLOYER which may have accrued upto the date of such termination.

30 Contractor remains liable to pay compensation if action not taken under clause 29:

30.1 In any case in which any of the powers conferred upon the EMPLOYER BY CLAUSE 29.0 thereof shall have become exercisable and the same had not been exercised, the non-exercise thereof shall not constitute a waiver of any of the conditions hereof and such powers shall notwithstanding be exercisable in the event of any further case of default by the CONTRACTOR for which by any clause or clauses hereof he is declared liable to pay compensation amounting to the whole of his Contract Performance Security, and the liability of the CONTRACTOR for past and future compensation shall remain unaffected. In the event of the EMPLOYER putting in force the power under above sub-clause (a), (b) or (c) vested in him under the preceding clause he may, if he so desired, take possession of all or any tools, and plants, materials and stores in or upon the works or the site thereof belonging to the CONTRACTOR or procured by him and intended to be used for the execution of the WORK or any part thereof paying or allowing for the same in account at the CONTRACT rates or in case of these not being applicable at current market rates to be certified by the ENGINEER-IN-CHARGE whose certificate thereof shall be final, otherwise the ENGINEER-IN-CHARGE may give notice in writing to the CONTRACTOR or his clerk of the works, foreman or other authorized agent, requiring him to remove such tools, plant, materials or stores from the premises (within a time to be specified in such notice), and in the event of the CONTRACTOR failing to comply with any such requisition, the ENGINEER-IN-CHARGE may remove them at the CONTRACTOR's expense or sell them by auction or private sale on account of the CONTRACTOR and at his risk in all respects without any further



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notice as to the date, time or place of sale and the certificate of the ENGINEER-IN-CHARGE as to the expenses of any such removal and the amount of the proceeds and expenses of any such sale shall be final and conclusive against the CONTRACTOR.

- 31 Change in constitution:** 31.1 Where the CONTRACTOR is a partnership firm, the prior approval of the EMPLOYER shall be obtained in writing, before any change is made in the constitution of the firm. Where the CONTRACTOR is an individual or a Hindu undivided family business concern, such approval as aforesaid shall, likewise be obtained before such CONTRACTOR enters into any agreement with other parties, where under, the reconstituted firm would have the right to carry out the work hereby undertaken by the CONTRACTOR. In either case if prior approval as aforesaid is not obtained, the CONTRACT shall be deemed to have been allotted in contravention of clause 37 hereof and the same action may be taken and the same consequence shall ensue as provided in the said clause.
- 32 Termination of contract**
- 32(A) **TERMINATION OF CONTRACT FOR DEATH:**
If the CONTRACTOR is an individual or a proprietary concern and the individual or the proprietor dies or if the CONTRACTOR is a partnership concern and one of the partner dies then unless, the EMPLOYER is satisfied that the legal representative of the individual or the proprietary concern or the surviving partners are capable of carrying out and completing CONTRACT, he (the EMPLOYER) is entitled to cancel the CONTRACT for the uncompleted part without being in any way liable for any compensation payment to the estate of the deceased CONTRACTOR and/or to the surviving partners of the CONTRACTOR'S firm on account of the cancellation of CONTRACT. The decision of the EMPLOYER in such assessment shall be final and binding on the parties. In the event of such cancellation, the EMPLOYER shall not hold the estate of the deceased CONTRACTOR and/or the surviving partners of the CONTRACTOR'S firm liable for any damages for non-completion of CONTRACT.
- 32(B) **TERMINATION OF CONTRACT IN CASE OF LIQUIDATION / BANKRUPTCY ETC.**

If the Contractor shall dissolve or become bankrupt or insolvent or cause or suffer any receiver to be appointed of his business or any assets thereof compound with his Creditors, or being a corporation commence to be wound up, not being a member's voluntary winding up for the purpose of amalgamation or reconstruction, or carry on its business under a Receiver for the benefits of its Creditors any of them, EMPLOYER shall be at liberty :-

To terminate the contract forthwith upon coming to know of the happening of any such event as aforesaid by notice in writing to the Contractor or to give the Receiver or liquidator or other person, the option of carrying out the contract subject to his providing a guarantee up to an amount to be agreed upon by EMPLOYER for due and faithful performance of the contract.
- 32 (C) In case of termination of CONTRACT herein set forth (under clause 29.0) except under conditions of Force Majeure and termination after expiry of contract, the CONTRACTOR shall be put under holiday [i.e. neither any enquiry will be issued to the party by Talcher Fertilizers Ltd. against any type of tender nor their offer will be considered by TFL against any ongoing tender (s) where contract between TFL and that particular CONTRACTOR (as a bidder) has not been finalized] for three years from the date of termination by Talcher Fertilizers Ltd. to such CONTRACTOR.
- 33 Members of the employer not individually liable :** 33.1 No Director, or official or employee of the EMPLOYER/ CONSULTANT shall in any way be personally bound or liable for the acts or obligations of the

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EMPLOYER under the CONTRACT or answerable for any default or omission in the observance or performance of any of the acts, matters or things which are herein contained.

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| 34 Employer not bound by personal representations: | 34.1 | The CONTRACTOR shall not be entitled to any increase on the scheduled rates or any other right or claim whatsoever by reason of any representation, explanation statement or alleged representation, promise or guarantees given or alleged to have been given to him by any person. |
| 35 Contractor's office at site: | 35.1 | The CONTRACTOR shall provide and maintain an office at the site for the accommodation of his agent and staff and such office shall be open at all reasonable hours to receive instructions, notice or other communications. The CONTRACTOR at all time shall maintain a site instruction book and compliance of these shall be communicated to the ENGINEER-IN CHARGE from time to time and the whole document to be preserved and handed over after completion of works. |
| 36 Contractor's subordinate staff and their conduct | 36.1 | The CONTRACTOR, on or after award of the WORK shall name and depute a qualified engineer having sufficient experience in carrying out work of similar nature, to whom the equipments, materials, if any, shall be issued and instructions for works given. The CONTRACTOR shall also provide to the satisfaction of the ENGINEER-IN-CHARGE sufficient and qualified staff to superintend the execution of the WORK, competent sub-agents, foremen and leading hands including those specially qualified by previous experience to supervise the types of works comprised in the CONTRACT in such manner as will ensure work of the best quality, expeditious working. Whenever in the opinion of the ENGINEER-IN- CHARGE additional properly qualified supervisory staff is considered necessary, they shall be employed by the CONTRACTOR without additional charge on accounts thereof. The CONTRACTOR shall ensure to the satisfaction of the ENGINEER-IN-CHARGE that SUB-CONTRACTORS, if any, shall provide competent and efficient supervision, over the work entrusted to them. |
| | 36.2 | If and whenever any of the CONTRACTOR's or SUB- CONTRACTOR'S agents, sub-agents, assistants, foremen, or other employees shall in the opinion of ENGINEER-IN- CHARGE be guilty of any misconduct or be incompetent or insufficiently qualified or negligent in the performance of their duties of that in the opinion of the EMPLOYER or the ENGINEER-IN-CHARGE, it is undesirable for administrative or any other reason for such person or persons to be employed in the works, the CONTRACTOR, is so directed by the ENGINEER-IN-CHARGE, shall at once remove such person or persons from employment thereon. Any person or persons so removed from the works shall not again be employed in connection with the WORKS without the written permission of the ENGINEER-IN- CHARGE. Any person so removed from the WORK shall be immediately re-placed at the expense of the CONTRACTOR by a qualified and competent substitute. Should the CONTRACTOR be requested to repatriate any person removed from the works he shall do so and shall bear all costs in connection herewith. |
| | 36.3 | The CONTRACTOR shall be responsible for the proper behavior of all the staff, foremen, workmen, and others, and shall exercise a proper degree of control over them and in particular and without prejudice to the said generality, the CONTRACTOR shall be bound to prohibit and prevent any employees from trespassing or acting in any way detrimental or prejudicial to the interest of the community or of the properties or occupiers of land and properties in the neighborhood and in the event of such employee so trespassing, the CONTRACTOR shall be responsible therefore and relieve the EMPLOYER of all consequent claims or actions for damages or injury or any other grounds |



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whatsoever. The decision of the ENGINEER-IN-CHARGE upon any matter arising under this clause shall be final. The CONTRACTOR shall be liable for any liability to EMPLOYER on account of deployment of CONTRACTOR's staff etc. or incidental or arising out of the execution of CONTRACT.

The CONTRACTOR shall be liable for all acts or omissions on the part of his staff, Foremen and Workmen and others in his employment, including misfeasance or negligence of whatever kind in the course of their work or during their employment, which are connected directly or indirectly with the CONTRACT.

36.4 If and when required by the EMPLOYER and CONTRACTOR's personnel entering upon the EMPLOYER's premises shall be properly identified by badges of a type acceptable to the EMPLOYER which must be worn at all times on EMPLOYER's premises. CONTRACTOR may be required to obtain daily entry passes for his staff/employees from EMPLOYER to work within operating areas. These being safety requirements, no relaxations on this account shall be given to CONTRACTOR.

37 Sub-letting of works:

37.1 No part of the CONTRACT nor any share or interest therein shall in any manner or degree be transferred, assigned or sublet by the CONTRACTOR directly or indirectly to any person, firm or corporation whatsoever without the consent in writing, of the ENGINEER/ EMPLOYER except as provided for in the succeeding sub-clause.

i) **SUB-CONTRACTS FOR TEMPORARY WORKS ETC.:**

The EMPLOYER may give written consent to Sub- contract for the execution of any part of the WORK at the site, being entered in to by CONTRACTOR provided each individual Sub- contract is submitted to the ENGINEER-IN-CHARGE before being entered into and is approved by him.

ii) **LIST OF SUB-CONTRACTORS TO BE SUPPLIED:**



At the commencement of every month the CONTRACTOR shall furnish to the ENGINEER-IN- CHARGE list of all SUB-CONTRACTORS or other persons or firms engaged by the CONTRACTOR and working at the SITE during the previous month with particulars of the general nature of the Subcontract or works done by them.

iii) **CONTRACTOR'S LIABILITY NOT LIMITED BY SUB-CONTRACTORS:**

Notwithstanding any sub-letting with such approval as aforesaid and notwithstanding that the ENGINEER-IN-CHARGE shall have received copies of any Subcontracts, the contractor shall be and shall remain solely responsible for the quality, proper and expeditious execution of the Contract in all respects as if such sub-letting or Subcontracting had not taken place, and as if such work had been done directly by the CONTRACTOR. The CONTRACTOR shall bear all responsibility for any act or omission on the part of sub-contractors in regard to work to be performed under the CONTRACT.

iv) **EMPLOYER MAY TERMINATE SUB-CONTRACTS:**

If any SUB-CONTRACTOR engaged upon the works at the site

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executes any works which in the opinion of the ENGINEER-IN-CHARGE is not in accordance with the CONTRACT documents, the EMPLOYER may by written notice to the CONTRACTOR request him to terminate such subcontract and the CONTRACTOR upon the receipt of such notice shall terminate such Subcontract and dismiss the SUB-CONTRACTOR(S) and the later shall forthwith leave the works, failing which the EMPLOYER shall have the right to remove such SUB- CONTRACTOR(S) from the site.

v) **NO REMEDY FOR ACTION TAKEN UNDER THIS CLAUSE:**



No action taken by the EMPLOYER under the clause shall relieve the CONTRACTOR of any of his liabilities under the CONTRACT or give rise to any right or compensation, extension of time or otherwise failing which the EMPLOYER shall have the right to remove such SUB-CONTRACTOR(S) from the site.

38 Power of entry:

38.1 If the CONTRACTOR shall not commence the WORK in the manner previously described in the CONTRACT documents or if he shall at any time in the opinion of the ENGINEER-IN-CHARGE.



- i) fail to carry out the WORK in conformity with the CONTRACT documents, or
- ii) fail to carry out the WORK in accordance with the Time Schedule, or
- iii) substantially suspend work or the WORK for a period of fourteen days without authority from the ENGINEER-IN-CHARGE, or
- iv) fail to carry out and execute the WORK to the satisfaction of the ENGINEER-IN-CHARGE, or
- v) fail to supply sufficient or suitable construction plant, temporary works, labour, materials or things, or
- vi) Commit, suffer, or permit any other breach of any of the provisions of the CONTRACT on his part to be performed or observed or persist in any of the above mentioned breaches of the CONTRACT for fourteen days, after notice in writing shall have been given to the CONTRACTOR by the ENGINEER-IN-CHARGE requiring such breach to be remedied, or
- vii) if the CONTRACTOR shall abandon the WORK or
- viii) If the CONTRACTOR during the continuance of the CONTRACT shall become bankrupt, make any arrangement or composition with his creditors, or permit any execution to be levied or go into liquidation whether compulsory or voluntary not being merely a voluntary liquidation for the purpose of amalgamation or reconstruction

then in any such case, the EMPLOYER shall have the power to enter upon the WORK and take possession thereof and of the materials, temporary WORK, construction plant, and stock thereon, and to revoke the CONTRACTOR's license to use the same, and to complete the WORK by his agents, other CONTRACTORS or workmen or to relate the same upon any terms and to such

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other person, firm or corporation as the EMPLOYER in his absolute discretion may think proper to employ and for the purpose aforesaid to use or authorize the use of any materials, temporary work, CONSTRUCTION PLANT, and stock as aforesaid, without making payment or allowance to the CONTRACTOR for the said materials other than such as may be certified in writing by the ENGINEER-IN-CHARGE to be reasonable, and without making any payment or allowance to the CONTRACTOR for the use of the temporary said works, construction plant and stock or being liable for any loss or damage thereto, and if the EMPLOYER shall by reason of his taking possession of the WORK or of the WORK being completed by other CONTRACTOR (due account being taken of any such extra work or works which may or be omitted) then the amount of such excess as certified by the ENGINEER-IN-CHARGE shall be deducted from any money which may be due for work done by the CONTRACTOR under the CONTRACT and not paid for. Any deficiency shall forthwith be made good and paid to the EMPLOYER by the CONTRACTOR and the EMPLOYER shall have power to sell in such manner and for such price as he may think fit all or any of the construction plant, materials etc. constructed by or belonging to and to recoup and retain the said deficiency or any part thereof out of proceeds of the sale.

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| <p>39 Contractor's responsibility with the mechanical, electrical, intercommunication system, air-conditioning contractors and other agencies:</p> | <p>39.1</p> | <p>Without repugnance of any other condition, it shall be the responsibility of the CONTRACTOR executing the work of civil construction, to work in close cooperation and coordinate the WORK with the Mechanical, Electrical, Air-conditioning and Intercommunication Contractor's and other agencies or their authorized representatives, in providing the necessary grooves, recesses, cuts and opening etc., in wall, slabs beams and columns etc. and making good the same to the desired finish as per specification, for the placement of electrical, intercommunication cables, conduits, air-conditioning inlets and outlets grills and other equipments etc. where required. For the above said requirements in the false ceiling and other partitions, the CONTRACTOR before starting-up the work shall in consultation with the Electrical, Mechanical, Intercommunication, Air-conditioning contractor and other agencies prepare and put-up a joint scheme, showing the necessary openings, grooves, recesses, cuts, the methods of fixing required for the WORK of the aforesaid, and the finishes therein, to the ENGINEER-IN-CHARGE and get the approval. The CONTRACTOR before finally submitting the scheme to the ENGINEER-IN-CHARGE, shall have the written agreement of the other agencies. The ENGINEER- IN-CHARGE, before communicating his approval to the scheme, with any required modification, shall get the final agreement of all the agencies, which shall be binding. No claim shall be entertained on account of the above.</p> <p>The CONTRACTOR shall confirm in all respects with provision of any statutory regulations, ordinances or byelaws of any local or duly constituted authorities or public bodies which may be applicable from time to time to the WORK or any temporary works. The CONTRACTOR shall keep the EMPLOYER indemnified against all penalties and liabilities of every kind, arising out of non- adherence to such stains, ordinances, laws, rules, regulations, etc.</p> |
| <p>40 Other agencies at site:</p> | <p>40.1</p> | <p>The CONTRACTOR shall have to execute the WORK in such place and conditions where other agencies will also be engaged for other works such as site grading, filling, and leveling, electrical and mechanical engineering works, etc. No claim shall be entertained due to WORK being executed in the above circumstances.</p> |
| <p>41 Notice:</p> | <p>41.1</p> | <p><u>TO THE CONTRACTOR:</u></p> <p>Any notice hereunder may be served on the CONTRACTOR or his duly authorized representative at the job site or may be served by registered mail direct to the address furnished by the CONTRACTOR. Proof of issue of any such notice could be conclusive of the CONTRACTOR having been duly informed of all</p> |

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contents therein.

41.2 TO THE EMPLOYER:



Any notice to be given to the EMPLOYER under the terms of the CONTRACTOR shall be served by sending the same by Registered mail to or delivering the same at the respective site offices of M/s Talcher Fertilizers Ltd. addressed to the HEAD/SITE-IN-CHARGE.

42 Right of various interests:

- i) The EMPLOYER reserves the right to distribute the work between more than one agency(ies). The CONTRACTOR shall cooperate and afford other agency(ies) reasonable opportunity for access to the WORK for the carriage and storage of materials and execution of their works.
- ii) Wherever the work being done by any department of the EMPLOYER or by other agency(ies) employed by the EMPLOYER is contingent upon WORK covered by this CONTRACT, the respective rights of the various interests involved shall be determined by the ENGINEER-IN-CHARGE to secure the completion of the various portions of the work in general harmony.

43 Patents and royalties:

- 43.1 The CONTRACTOR, if licensed under any patent covering equipment, machinery, materials or compositions of matter to be used or supplied or methods and process to be practiced or employed in the performance of this CONTRACT, agrees to pay all royalties and license fees which may be due with respect thereto. If any equipment, machinery, materials, composition of matters, be used or supplied or methods and processes to be practiced or employed in the performance of this CONTRACT, is covered by a patent under which the CONTRACTOR is not licensed then the CONTRACTOR before supplying or using the equipment, machinery materials, composition method or processes shall obtain such licenses and pay such royalties and license fees as may be necessary for performance of this CONTRACT. In the event the CONTRACTOR fails to pay any such royalty or obtain any such license, any suit for infringement of such patents which is brought against the CONTRACTOR or the EMPLOYER as a result such failure will be defended by the CONTRACTOR at his own expense and the CONTRACTOR will pay any damages and costs awarded in such suit. The CONTRACTOR shall promptly notify the EMPLOYER if the CONTRACTOR has acquired the knowledge of any plant under which a suit for infringement could be reasonably brought because of the use by the EMPLOYER of any equipment, machinery, materials, process, methods to be supplied hereunder. The CONTRACTOR agrees to and does hereby grant to EMPLOYER, together with the right to extend the same to any of the subsidiaries of the EMPLOYER as irrevocable, royalty free license to use in any country, any invention made by the CONTRACTOR or his employee in or as result of the performance of the WORK under the CONTRACT.
- 43.2 All charges on account of royalty, toilage, rent, octroi terminal or sales tax and/ or other duties or any other levy on materials obtained for the work or temporary work or part thereof (excluding materials provided by the EMPLOYER) shall be borne by the CONTRACTOR.
- 43.3 The CONTRACTOR shall not sell or otherwise dispose of or remove except for the purpose of this CONTRACT, the sand, stone, clay, ballast, earth, rock or other substances, or materials obtained from any excavation made for the purpose of the WORK or any building or produce upon the site at the time of delivery of the possession thereof, but all such substances, materials, buildings and produce shall be the property of the EMPLOYER provided that the CONTRACTOR may with the permission of the ENGINEER-IN-CHARGE, use the same for the purpose of the work by payment of cost of the same at such a rate as may be determined by

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the ENGINEER-IN- CHARGE.

43.4 The EMPLOYER shall indemnify and save harmless the CONTRACTOR from any loss on account of claims against CONTRACTOR for the contributory infringement of patent rights arising out and based upon the claim that the use of the EMPLOYER of the process included in the design prepared by the EMPLOYER and used in the operation of the plant infringes on any patent right. With respect to any subcontract entered into by CONTRACTOR pursuant to the provisions of the relevant clause hereof, the CONTRACTOR shall obtain from the SUB-CONTRACTOR an undertaking to provide the EMPLOYER with the same patent protection that CONTRACTOR is required to provide under the provisions of this clause.

44 Liens:

44.1 If, at any time there should be evidence or any lien or claim for which the EMPLOYER might have become liable and which is chargeable to the CONTRACTOR, the EMPLOYER shall have the right to retain out of any payment then due or thereafter to become due an amount sufficient to completely indemnify the EMPLOYER against such lien or claim and if such lien or claim be valid, the EMPLOYER may pay and discharge the same and deduct the amount so paid from any money which may be or may become due and payable to the CONTRACTOR. If any lien or claim remain unsettled after all payments are made, the CONTRACTOR shall refund or pay to the EMPLOYER all money that the latter may be compelled to pay in discharging such lien or claim including all costs and reasonable expenses. EMPLOYER reserves the right to do the same.

44.2 The EMPLOYER shall have lien on all materials, equipments including those brought by the CONTRACTOR for the purpose of erection, testing and commissioning of the WORK.



44.3 The final payment shall not become due until the CONTRACTOR delivers to the ENGINEER-IN-CHARGE a complete release or waiver of all liens arising or which may arise out of his agreement or receipt in full or certification by the CONTRACTOR in a form approved by ENGINEER-IN-CHARGE that all invoices for labour, materials, services have been paid in lien thereof and if required by the ENGINEER-IN-CHARGE in any case an affidavit that so far as the CONTRACTOR has knowledge or information the releases and receipts include all the labour and material for which a lien could be filled.

44.4 CONTRACTOR will indemnify and hold the EMPLOYER harmless, for a period of two years after the issue of FINAL CERTIFICATE, from all liens and other encumbrances against the EMPLOYER on account of debts or claims alleged to be due from the CONTRACTOR or his SUB-CONTRACTOR to any person including SUB- CONTRACTOR and on behalf of EMPLOYER will defend at his own expense, any claim or litigation brought against the EMPLOYER or the CONTRACTOR in connection therewith. CONTRACTOR shall defend or contest at his own expense any fresh claim or litigation by any person including his SUB-CONTRACTOR, till its satisfactory settlement even after the expiry of two years from the date of issue of FINAL CERTIFICATE.

45 Delays by employer or his authorized agents:



45.1 In case the CONTRACTOR's performance is delayed due to any act or omission on the part of the EMPLOYER or his authorized agents, then the CONTRACTOR shall be given due extension of time for the completion of the WORK, to the extent such omission on the part of the EMPLOYER has caused delay in the CONTRACTOR's performance of his WORK.

45.2 No adjustment in CONTRACT PRICE shall be allowed for reasons of such delays and extensions granted except as provided in TENDER DOCUMENT, where the EMPLOYER reserves the right to seek indulgence of CONTRACTOR to maintain the agreed Time Schedule of Completion.

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In such an event the CONTRACTOR shall be obliged for working by CONTRACTOR's personnel for additional time beyond stipulated working hours as also Sundays and Holidays and achieve the completion date/interim targets.



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| 46 Payment if the contract is terminated: | 46.1 | <p>If the CONTRACT shall be terminated as per Tender pursuant to Clause no. 29 of GCC, the CONTRACTOR shall be paid by the EMPLOYER in so far as such amounts or items shall not have already been covered by payments of amounts made to the CONTRACTOR for the WORK executed and accepted by ENGINEER-IN-CHARGE prior to the date of termination at the rates and prices provided for in the CONTRACT and in addition to the following:</p> <p>a) The amount payable in respect of any preliminary items, so far as the Work or service comprised therein has been carried out or performed and an appropriate portion as certified by ENGINEER-IN-CHARGE of any such items or service comprised in which has been partially carried out or performed.</p> <p>b) Any other expenses which the CONTRACTOR has expended for performing the WORK under the CONTRACT subject to being duly recommended by ENGINEER-IN-CHARGE and approved by EMPLOYER for payment, based on documentary evidence of his having incurred such expenses.</p> |
| | 46.2 | <p>The CONTRACTOR will be further required to transfer the title and provide the following in the manner and as directed by the EMPLOYER.</p> <p>a) Any and all completed works.</p> <p>b) Such partially completed WORK including drawings, information's and CONTRACT rights as the CONTRACTOR has specially performed, produced or acquired for the performance of the CONTRACTOR.</p> |
| 47 No waiver of rights: | 47.1 | <p>Neither the inspection by the EMPLOYER or any of their officials, employees, or agents nor any order by the EMPLOYER for payment of money or any payment for or acceptance of the whole or any part of the Work by the EMPLOYER nor any extension of time, nor any possession taken by EMPLOYER shall operate as a waiver of any provision of the CONTRACT, or of any power herein reserved to the EMPLOYER, or any right to damages herein provided, nor shall any waiver of any breach in the CONTRACT be held to be a waiver of any other subsequent breach.</p> |
| 48 Certificate not to affect right of employer and liability of contractor: | 48.1 | <p>No interim payment certificate(s) issued by the Engineer-in-Charge of the EMPLOYER, nor any sum paid on account by the EMPLOYER, nor any extension of time for execution of the work granted by EMPLOYER shall affect or prejudice the rights of the Employer against the CONTRACTOR or relieve the CONTRACTOR of his obligations for the due performance of the CONTRACT, or be interpreted as approval of the WORK done or of the equipment supplied and no certificate shall create liability for the EMPLOYER to pay for alterations, amendments, variations or additional works not ordered, in writing, by EMPLOYER or discharge the liability of the CONTRACTOR for the payment of damages whether due, ascertained, or certified or not or any sum against the payment of which he is bound to indemnify the EMPLOYER.</p> |
| 49 Language and measures: | 49.1 | <p>All documents pertaining to the CONTRACT including Specifications, Schedules, Notices, Correspondence, operating and maintenance Instructions, DRAWINGS, or any other writing shall be written in English language. The Metric System of measurement shall be used in the CONTRACT unless otherwise specified.</p> |

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- 50 Transfer of title:**
- 50.1 The title of Ownership of supplies furnished by the CONTRACTOR shall not pass on to the EMPLOYER for all Supplies till the same are finally accepted by the EMPLOYER after the successful completion of PERFORMANCE TEST and GUARANTEE TEST and issue of FINAL CERTIFICATE.
- 50.2 However, the EMPLOYER shall have the lien on all such works performed as soon as any advance or progressive payment is made by the EMPLOYER to the CONTRACTOR and the CONTRACTOR shall not subject these works for use other than those intended under this CONTRACT.
- 51 Release of information:**
- 51.1 The CONTRACTOR shall not communicate or use in advertising, publicity, sales releases or in any other medium, photographs, or other reproduction of the Work under this CONTRACT or description of the site dimensions, quantity, quality or other information, concerning the Work unless prior written permission has been obtained from the EMPLOYER.
- 52 Brand names:**
- 52.1 The specific reference in the SPECIFICATIONS and documents to any material by trade name, make or catalogue number shall be construed as establishing standard or quality and performance and not as limited competition. However, TENDERER may offer other similar equipments provided it meets the specified standard design and performance requirements.
- 53 Completion of contract:**
- 53.1 Unless otherwise terminated under the provisions of any other relevant clause, this CONTRACT shall be deemed to have been completed at the expiration of the PERIOD OF LIABILITY as provided for under the CONTRACT.
- 54 Spares:**
- 54.1 The CONTRACTOR shall furnish to the EMPLOYER all spares required for COMMISSIONING of the plants, recommendatory and/or mandatory spares, which are required essential by the manufacturer/supplier. The same shall be delivered at SITE, 3(Three) months before COMMISSIONING.
- Also the CONTRACTOR should furnish the manufacturing drawings for fast wearing spares.
- 54.2 The CONTRACTOR guarantees the EMPLOYER that before the manufacturers of the equipments, plants and machineries go out of production of spare parts for the equipment furnished and erected by him, he shall give at least twelve (12) months' advance notice to the EMPLOYER, so that the latter may order his requirement of spares in one lot, if he so desires.

SECTION-V Performance of Work

- 55 Execution of work:**
- 55.1 All the Works shall be executed in strict conformity with the provisions of the CONTRACT Documents and with such explanatory detailed drawings, specification and instructions as may be furnished from time to time to the CONTRACTOR by the ENGINEER-IN-CHARGE whether mentioned in the CONTRACT or not. The CONTRACTOR shall be responsible for ensuring that works throughout are executed in the most substantial, proper and workmanlike manner with the quality of material and workmanship in strict accordance with the SPECIFICATIONS and to the entire satisfaction of the ENGINEER-IN-CHARGE. The CONTRACTOR shall provide all necessary materials equipment labour etc. for execution and maintenance of WORK till completion unless otherwise mentioned in the CONTRACT.
- 56 Co-ordination and inspection of work:**
- 56.1 The coordination and inspection of the day-to-day work under the CONTRACT shall be the responsibility of the ENGINEER-IN-CHARGE. The written instruction regarding any particular job will normally be passed by the ENGINEER-IN-CHARGE or his authorized representative. A work order book

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will be maintained by the CONTRACTOR for each sector in which the aforesaid written instructions will be entered. These will be signed by the CONTRACTOR or his authorized representative by way of acknowledgement within 12 hours.

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| 57 | Work in monsoon and dewatering: | 57.1 | Unless otherwise specified elsewhere in the tender, the execution of the WORK may entail working in the monsoon also. The CONTRACTOR must maintain a minimum labour force as may be required for the job and plan and execute the construction and erection according to the prescribed schedule. No extra rate will be considered for such work in monsoon. |
| | | 57.2 | During monsoon and other period, it shall be the responsibility of the CONTRACTOR to keep the construction work site free from water at his own cost. |
| 58 | Work on sundays and holidays: | 58.1 | For carrying out Work on Sundays, and Holidays, the CONTRACTOR will approach the ENGINEER-IN-CHARGE or his representative at least two days in advance and obtain permission in writing. The CONTRACTOR shall observe all labour laws and other statutory rules and regulations in force. In case of any violations of such laws, rules and regulations, consequence if any, including the cost thereto shall be exclusively borne by the CONTRACTOR and the EMPLOYER shall have no liability whatsoever on this account. |
| 59 | General conditions for construction and erection work: | 59.1 | The working time at the site of work is 48 hours per week. Overtime work is permitted in cases of need and the EMPLOYER will not compensate the same. Shift working at 2 or 3 shifts per day will become necessary and the CONTRACTOR should take this aspect into consideration for formulating his rates for quotation. No extra claims will be entertained by the EMPLOYER on this account. For carrying out work beyond working hours the CONTRACTOR will approach the ENGINEER-IN-CHARGE or his authorized representative and obtain his prior written permission. |
| | | 59.2 | The CONTRACTOR must arrange for the placement of workers in such a way that the delayed completion of the WORK or any part thereof for any reason whatsoever will not affect their proper employment. The EMPLOYER will not entertain any claim for idle time payment whatsoever. |
| | | 59.3 | The CONTRACTOR shall submit to the EMPLOYER/ ENGINEER-IN-CHARGE reports at regular intervals regarding the state and progress of WORK. The details and proforma of the report will mutually be agreed after the award of CONTRACT. The CONTRACTOR shall provide display boards showing progress and labour strengths at worksite, as directed by the ENGINEER-IN-CHARGE. |
| 60 | Alterations in specifications, design and extra works: | 60.1 | The WORK covered under this CONTRACT having to be executed by the CONTRACTOR on a lumpsum firm price/item rate quoted by him, the EMPLOYER will not accept any proposals for changes in VALUE OF CONTRACT or extension in time on account of any such changes which may arise to the CONTRACTOR's scope of WORK as a result of detailed Engineering and thereafter during the execution of WORK. The only exception to this will be a case where the EMPLOYER requests in writing to the CONTRACTOR to upgrade the SPECIFICATIONS or the size of any major pieces of equipments, plant or machinery beyond what is normally required to meet the scope of WORK as defined in the CONTRACT DOCUMENT. |
| | | | In such cases, a change order will be initialled by the CONTRACTOR at the appropriate time for the EMPLOYER's prior approval giving the full back-up data for their review and for final settlement of any impact on price within 30 (thirty) days thereafter. |
| | | 60.2 | The ENGINEER-IN-CHARGE shall have to make any alterations in, omission |



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from, additions to or substitutions for, the Schedule of Rates, the original specifications, drawings, designs and instructions that may appear to him to be necessary or advisable during the progress of the WORK and the CONTRACTOR shall be bound to carry out the such altered/ extra/ new items of WORK in accordance with any instructions which may be given to him in writing signed by the ENGINEER-IN- CHARGE, and such alterations, omissions, additions or substitutions shall not invalidate the CONTRACT and any altered, additional or substituted work which the CONTRACTOR may be directed to do in the manner above specified as part of the WORK shall be carried out by the CONTRACTOR on the same conditions in all respects on which he agreed to do the main WORK. The time of completion of WORK may be extended for the part of the particular job at the discretion of the ENGINEER-IN- CHARGE, for only such alterations, additions or substitutions of the WORK, as he may consider as just and reasonable. The rates for such additional, altered or substituted WORK under this clause shall be worked out in accordance with the following provisions:-

I. For Item Rate Contract

- a) If the rates for the additional, altered or substituted WORK are specified in the CONTRACT for the WORK, the CONTRACTOR is bound to carry on the additional, altered or substituted WORK at the same rates as are specified in the CONTRACT.
- b) If the rates for the additional, altered or substituted WORK are not specifically provided in the CONTRACT for the WORK, the rates will be derived from the rates for similar class of WORK as are specified in the CONTRACT for the WORK. The opinion of the ENGINEER-IN- CHARGE, as to whether or not the rates can be reasonably so derived from the items in this CONTRACT will be final and binding on the CONTRACTOR.
- c) If the rates for the altered, additional or substituted WORK cannot be determined in the manner specified in sub-clause(s) (a) and (b) above, then the CONTRACTOR shall, within 7 days of the date of receipt of order to carry out the WORK, inform the ENGINEER-IN-CHARGE of the rates which it is his intention to charge for such class of WORK, supported by analysis of the rate or rates claimed, and the ENGINEER-IN-CHARGE shall determine the rate or rates on the basis of the prevailing market rates, labour cost at schedule of labour rates plus 10% to cover contractor's supervision, overheads and profit and pay the CONTRACTOR accordingly. The opinion of the ENGINEER- IN-CHARGE as to current market rates of materials and the quantum of labour involved per unit of measurement will be final and binding on the CONTRACTOR.
- d) Where the item of work will be executed through nominated specialist agency as approved by the ENGINEER-IN-CHARGE, then the actual amount paid to such nominated agency supported by documentary evidence and as certified by ENGINEER-IN-CHARGE shall be considered plus 10% (ten percent) to cover all contingencies, overhead, profits to arrive at the rates.
- e) Provisions contained in the Sub-clause (a) & (d) above shall, however, not apply for the following:-



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Where the value of additions of new items together with the value of alterations, additions/ deletions or substitutions does not exceed by or is not less than plus/minus ()25% of the VALUE OF CONTRACT. The item rates in the Schedule of Rates shall hold good for all such variations between the above mentioned limits, irrespective of any increase/decrease of quantities in the individual items of Schedule of Rates.

Where the value of addition of new items together with the value of alterations, additions/ deletions or substitutions reduces more than 25% of the contract value but is within the following limits the tenderer shall be paid compensation for decrease in the value of work, as follows:



S.No.	Range of Variation	Percentage compensation for decrease in the value of work in the respective range.
a)	Beyond (+) 25% upto & inclusive of (+) 50%	No increase and/ or decrease shall be applicable for the Schedule of Rates (The rates quoted for this increase shall be valid).
b)	Beyond (-) 25% upto & inclusive of (-) 50%	For reduction beyond 25% contractor shall be compensated by an amount equivalent to 10% of the reduction in value of the contract as awarded. For example if the actual contract value is 70% of awarded value then compensation shall be 10% of (75-70) i.e. 0.5% of awarded contract value.

II. For Lumpsum Contracts

CONTRACTOR shall, within 7 days of the date of receipt of order to carry out the WORK, inform the ENGINEER-IN- CHARGE of the rates which it is his intention to charge for such class of WORK, supported by analysis of the rate or rates claimed, and the ENGINEER-IN-CHARGE shall determine the rate or rates on the basis of the prevailing market rates, labour cost at schedule of labour rates plus 10% to cover contractor's supervision, overheads and profit and pay the CONTRACTOR accordingly. The opinion of the ENGINEER-IN-CHARGE as to current market rates of materials and the quantum of labour involved per unit of measurement will be final and binding on the CONTRACTOR.

61 Drawings to be supplied by the employer

- 61.1 The drawings attached with tender are only for the general guidance to the CONTRACTOR to enable him to visualize the type of work contemplated and scope of work involved. The CONTRACTOR will be deemed to have studied the DRAWINGS and formed an idea about the WORK involved.
- 61.2 Detailed working drawings on the basis of which actual execution of the WORK is to proceed, will be furnished from time to time during the progress of the work. The CONTRACTOR shall be deemed to have gone through the DRAWINGS supplied to him thoroughly and carefully and in conjunction with all other connected drawings and bring to the notice of the ENGINEER-IN-CHARGE discrepancies, if any, therein before actually carrying out the Work.
- 61.3 Copies of all detailed working drawings relating to the WORK shall be kept at the CONTRACTOR's office on the site and shall be made available to the

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ENGINEER-IN- CHARGE at any time during the CONTRACT. The drawings and other documents issued by the EMPLOYER shall be returned to the EMPLOYER on completion of the WORK.

62 Drawings to be supplied by the contractor:

62.1 The drawings/date which are to be furnished by the CONTRACTOR are enumerated in the special conditions of contract, and shall be furnished within the specified time.

62.2 Where approval/review of drawings before manufacture/ construction/fabrication has been specified, it shall be CONTRACTOR's responsibility to have these drawings prepared as per the directions of ENGINEER-IN-CHARGE and got approved before proceeding with manufacture/construction/fabrication as the case may be. Any change that may have become necessary in these drawings during the execution of the work shall have to be carried out by the CONTRACTOR to the satisfaction of ENGINEER-IN-CHARGE at no extra cost. All final drawings shall bear the certification stamp as indicated below duly signed by both the CONTRACTOR and ENGINEER-IN-CHARGE.

"Certified true for _____ (Name of Work)

Agreement No. _____

Signed: _____
(CONTRACTOR) (ENGINEER-IN-CHARGE)

62.3 The DRAWINGS submitted by the CONTRACTOR shall be reviewed by the ENGINEER-IN-CHARGE as far as practicable within 3 (Three) weeks and shall be modified by the CONTRACTOR, if any modifications and/or corrections are required by the ENGINEER-IN-CHARGE. The CONTRACTOR shall incorporate such modifications and/or corrections and submit the final drawings for approval. Any delays arising out of failure by the CONTRACTOR to rectify the drawing in good time shall not alter the Contract Completion Time.



62.4 As built drawings showing all corrections, adjustments etc. shall be furnished by the CONTRACTOR in six copies and one transparent for record purposed to the EMPLOYER.

63 Setting out works:

63.1 The ENGINEER-IN-CHARGE shall furnish the CONTRACTOR with only the four corners of the Works site and a level bench mark and the CONTRACTOR shall set out the Works and shall provide an efficient staff for the purpose and shall be solely responsible for the accuracy of such setting out.



63.2 The CONTRACTOR shall provide, fix and be responsible for the maintenance of all stakes, templates, level marks, profiles and other similar things and shall take all necessary precautions to prevent their removal or disturbance and shall be responsible for the consequence of such removal or disturbance should the same take place and for their efficient and timely reinstatement. The CONTRACTOR shall also be responsible for the maintenance of all existing survey marks, boundary marks, distance marks and center line marks, either existing or supplied and fixed by the CONTRACTOR. The work shall be set out to the satisfaction of the ENGINEER-IN-CHARGE. The approval there of joining with the CONTRACTOR by the ENGINEER- IN-CHARGE in setting out the work, shall not relieve the CONTRACTOR of any of his responsibility.

63.3 Before beginning the Works, the CONTRACTOR shall at his own cost, provide all necessary reference and level posts, pegs, bamboos, flags, ranging rods, strings and other materials for proper layout of the works in accordance with the schemes for bearing marks acceptable to the ENGINEER-IN-CHARGE. The center, longitudinal or face lines and cross lines shall be marked by means of small masonry pillars. Each pillar shall have distinct mark at the centre to enable

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theodolite to be set over it. No work shall be started until all these points are checked and approved by the ENGINEER-IN-CHARGE in writing but such approval shall not relieve the CONTRACTOR of any of his responsibilities. The CONTRACTOR shall also provide all labour, material and other facilities, as necessary, for the proper checking of layout and inspection of the points during construction.

- 63.4 Pillars bearing geodetic marks located at the sites of units of WORKS under construction should be protected and fenced by the CONTRACTOR.
- 63.5 On completion of WORK, the CONTRACTOR must submit the geodetic documents according to which the WORK was carried out.
- 64 Responsibility for level and alignment:**
- 64.1 The CONTRACTOR shall be entirely and exclusively responsible for the horizontal and vertical alignment, the levels and correctness of every part of the WORK and shall rectify effectively any errors or imperfections therein, such rectifications shall be carried out by the CONTRACTOR, at his own cost, when instructions are issued to that effect by the ENGINEER- IN-CHARGE.
- 65 Materials to be supplied by contractor:**
- 65.1 The CONTRACTOR shall procure and provide within the VALUE OF CONTRACT the whole of the materials required for the construction including steels, cement and other building materials, tools, tackles, construction plant and equipment for the completion and maintenance of the WORK except the materials which will be issued by the EMPLOYER and shall make his own arrangement for procuring such materials and for the transport thereof. The EMPLOYER may give necessary recommendation to the respective authority if so desired by the CONTRACTOR but assumes no further responsibility of any nature. The EMPLOYER will insist on the procurement of materials which bear ISI stamp and/or which are supplied by reputed suppliers.
- 65.2 The CONTRACTOR shall properly store all materials either issued to him or brought by him to the SITE to prevent damages due to rain, wind, direct exposure to sun, etc. as also from theft, pilferage, etc. for proper and speedy execution of his works. The CONTRACTOR shall maintain sufficient stocks of all materials required by him.
- 65.3 No material shall be dispatched from the CONTRACTOR's stores before obtaining the approval in writing of the ENGINEER-IN-CHARGE.
- 66 Stores supplied by the employer:**
- (Clause not applicable for this Tender)*
- 66.1 If the SPECIFICATION of the WORK provides for the use of any material of special description to be supplied from the EMPLOYER's stores or it is required that the CONTRACTOR shall use certain stores to be provided by the ENGINEER-IN-CHARGE, such materials and stores, and price to be charged there for as hereinafter mentioned being so far as practicable for the convenience of the CONTRACTOR, but not so as in any way to control the meaning or effect of the CONTRACT, the CONTRACTOR shall be bound to purchase and shall be supplied such materials and stores as are from time to time required to be used by him for the purpose of the CONTRACT only. The sums due from the CONTRACTOR for the value of materials supplied by the EMPLOYER will be recovered from the running account bill on the basis of the actual consumption of materials in the works covered and for which the running account bill has been prepared. After the completion of the WORK, however, the CONTRACTOR has to account for the full quantity of materials supplied to him as per relevant clauses in this document.
- 66.2 The value of the stores/materials as may be supplied to the CONTRACTOR by the EMPLOYER will be debited to the CONTRACTOR's account at the rates shown in the schedule of materials and if they are not entered in the schedule, they will be debited at cost price, which for the purpose of the CONTRACT shall include the cost of carriage and all other expenses whatsoever such as normal

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storage supervision charges which shall have been incurred in obtaining the same at the EMPLOYER's stores. All materials so supplied to the CONTRACTOR shall remain the absolute property of the EMPLOYER and shall not be removed on any account from the SITE of the WORK, and shall be at all times open for inspection to the ENGINEER-IN-CHARGE. Any such materials remaining unused at the time of the completion or termination of the CONTRACT shall be returned to the EMPLOYER's stores or at a place as directed by the ENGINEER-IN-CHARGE in perfectly good condition at CONTRACTOR's cost.

67 Conditions for issue of materials:

(Clause not applicable for this Tender)

- 67.1
- i) Materials specified as to be issued by the EMPLOYER will be supplied to the CONTRACTOR by the EMPLOYER from his stores. It shall be responsibility of the CONTRACTOR to take delivery of the materials and arrange for its loading, transport and unloading at the SITE of WORK at his own cost. The materials shall be issued between the working hours and as per the rules of the EMPLOYER as framed from time to time.
 - ii) The CONTRACTOR shall bear all incidental charges for the storage and safe custody of materials at site after these have been issued to him.
 - iii) Materials specified as to be issued by the EMPLOYER shall be issued in standard sizes as obtained from the manufacturers.
 - iv) The CONTRACTOR shall construct suitable Godowns at the SITE of WORK for storing the materials safe against damage by rain, dampness, fire, theft etc. He shall also employ necessary watch and ward establishment for the purpose.
 - v) It shall be duty of the CONTRACTOR to inspect the materials supplied to him at the time of taking delivery and satisfy himself that they are in good condition. After the materials have been delivered by the EMPLOYER, it shall be the responsibility of the CONTRACTOR to keep them in good condition and if the materials are damaged or lost, at any time, they shall be repaired and/or replaced by him at his own cost according to the instructions of the ENGINEER-IN-CHARGE.
 - vi) The EMPLOYER shall not be liable for delay in supply or non-supply of any materials which the EMPLOYER has undertaken to supply where such failure or delay is due to natural calamities, act of enemies, transport and procurement difficulties and any circumstances beyond the control of the EMPLOYER. In no case, the CONTRACTOR shall be entitled to claim any compensation or loss suffered by him on this account.
 - vii) It shall be responsibility of the CONTRACTOR to arrange in time all materials required for the WORK other than those to be supplied by the EMPLOYER. If, however, in the opinion of the ENGINEER-IN-CHARGE the execution of the WORK is likely to be delayed due to the CONTRACTOR's inability to make arrangements for supply of materials which normally he has to arrange for, the ENGINEER-IN-CHARGE shall have the right at his own discretion to issue such materials, if available with the EMPLOYER or procure the materials from the market or as elsewhere and the CONTRACTOR will be bound to take such materials at the rates decided by the ENGINEER-IN-CHARGE. This, however, does not in any way absolve the CONTRACTOR from responsibility of making arrangements for the supply of such materials in part or in full, should such a situation occur nor shall this constitute a reason for the delay in the execution of the WORK.



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- viii) None of the materials supplied to the CONTRACTOR will be utilized by the CONTRACTOR for manufacturing item which can be obtained as supplied from standard manufacturer in finished form.
- ix) The CONTRACTOR shall, if desired by the ENGINEER-IN-CHARGE, be required to execute an Indemnity Bond in the prescribed form for safe custody and accounting of all materials issued by the EMPLOYER.
- x) The CONTRACTOR shall furnish to the ENGINEER-IN-CHARGE sufficiently in advance a statement showing his requirement of the quantities of the materials to be supplied by the EMPLOYER and the time when the same will be required by him for the works, so as to enable the ENGINEER-IN-CHARGE to make necessary arrangements for procurement and supply of the material.
- xi) Account of the materials issued by the EMPLOYER shall be maintained by CONTRACTOR indicating the daily receipt, consumption and balance in hand. This account shall be maintained in a manner prescribed by the ENGINEER-IN-CHARGE along with all connected papers viz. requisitions, issues, etc., and shall be always available for inspection in the CONTRACTOR's office at SITE.
- xii) The CONTRACTOR should see that only the required quantities of materials are got issued. The CONTRACTOR shall not be entitled to cartage and incidental charges for returning the surplus materials, if any, to the stores wherefrom they were issued or to the place as directed by the ENGINEER-IN-CHARGE.
- xiii) Materials/ Equipment(s) supplied by EMPLOYER shall not be utilized for any purpose(s) than issued for.
- 68 Material procured with assistance of employer/ return of surplus:** 68.1 Notwithstanding anything contained to the contrary in any or all the clauses of this CONTRACT where any materials for the execution of the CONTRACT are procured with the assistance of the EMPLOYER either by issue from EMPLOYER's stock or purchases made under order or permits or licenses issued by Government, the CONTRACTOR shall hold the said materials as trustee for the EMPLOYER and use such materials economically and solely for the purpose of the CONTRACT and not dispose them off without the permission of the EMPLOYER and return, if required by the ENGINEER-IN-CHARGE, shall determine having due regard to the condition of the materials. The price allowed to the CONTRACTOR, however, shall not exceed the amount charged to him excluding the storage charges, if any. The decision of the ENGINEER-IN-CHARGE shall be final and conclusive in such matters. In the event of breach of the aforesaid condition, the CONTRACTOR shall, in terms of the licenses or permits and/or criminal breach of trust, be liable to compensate the EMPLOYER at double rate or any higher rate, in the event of those materials at that time having higher rate or not being available in the market, then any other rate to be determined by the ENGINEER-IN-CHARGE and his decision shall be final and conclusive.
- (Clause not applicable for this Tender)*
- 69 Materials obtained from dismantling:** 69.1 If the CONTRACTOR in the course of execution of the WORK is called upon to dismantle any part for reasons other than those stipulated in Clauses 74 and 77 hereunder, the materials obtained in the WORK of dismantling etc., will be considered as the EMPLOYER's property and will be disposed off to the best advantage of the EMPLOYER.
- 70 Articles of value found:** 70.1 All gold, silver and other minerals of any description and all precious stones, coins, treasure relics, antiquities and other similar things which shall be found in, under or upon the SITE, shall be the property of the EMPLOYER and the

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CONTRACTOR shall duly preserve the same to the satisfaction of the ENGINEER-IN-CHARGE and shall from time to time deliver the same to such person or persons indicated by the EMPLOYER.

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| 71 Discrepancies between instructions: | 71.1 | Should any discrepancy occur between the various instructions furnished to the CONTRACTOR, his agent or staff or any doubt arises as to the meaning of any such instructions or should there be any misunderstanding between the CONTRACTOR's staff and the ENGINEER-IN-CHARGE's staff, the CONTRACTOR shall refer the matter immediately in writing to the ENGINEER-IN-CHARGE whose decision thereon shall be final and conclusive and no claim for losses alleged to have been caused by such discrepancies between instructions, doubts, or misunderstanding shall in any event be admissible. |
| 72 Action where no specification is issued: | 72.1 | In case of any class of WORK for which there is no SPECIFICATION supplied by the EMPLOYER as mentioned in the Tender Documents such WORK shall be carried out in accordance with Indian Standard Specifications and if the Indian Standard Specifications do not cover the same, the WORK should be carried out as per standard Engineering Practice subject to the approval of the ENGINEER-IN-CHARGE. |
| 73 Inspection of works: | 73.1 | The ENGINEER-IN-CHARGE will have full power and authority to inspect the WORK at any time wherever in progress either on the SITE or at the CONTRACTOR's premises/workshops wherever situated, premises/ workshops of any person, firm or corporation where WORK in connection with the CONTRACT may be in hand or where materials are being or are to be supplied, and the CONTRACTOR shall afford or procure for the ENGINEER-IN-CHARGE every facility and assistance to carry out such inspection. The CONTRACTOR shall, at all time during the usual working hours and at all other time at which reasonable notice of the intention of the ENGINEER-IN-CHARGE or his representative to visit the WORK shall have been given to the CONTRACTOR, either himself be present or receive orders and instructions, or have a responsible agent duly accredited in writing, present for the purpose. Orders given to the CONTRACTOR's agent shall be considered to have the same force as if they had been given to the CONTRACTOR himself. The CONTRACTOR shall give not less than seven days notice in writing to the ENGINEER-IN-CHARGE before covering up or otherwise placing beyond reach of inspection and measurement of any work in order that the same may be inspected and measured. In the event of breach of above the same shall be uncovered at CONTRACTOR's expense for carrying out such measurement or inspection. |
| | 73.2 | No material shall be dispatched from the CONTRACTOR's stores before obtaining the approval in writing of the Engineer-in-Charge.

The CONTRACTOR is to provide at all time during the progress of the WORK and the maintenance period, proper means of access with ladders, gangways etc. and the necessary attendance to move and adopt as directed for inspection or measurements of the WORK by the ENGINEER-IN-CHARGE. |
| | 73.3 | The CONTRACTOR shall make available to the ENGINEER-IN-CHARGE free of cost all necessary instruments and assistance in checking or setting out of WORK and in the checking of any WORK made by the CONTRACTOR for the purpose of setting out and taking measurements of WORK. |
| 74 Tests for quality of work: | 74.1 | All workmanship shall be of the respective kinds described in the CONTRACT DOCUMENTS and in accordance with the instructions of the ENGINEER-IN-CHARGE and shall be subjected from time to time to such test at CONTRACTOR's cost as the ENGINEER-IN-CHARGE may direct at the place of manufacture or fabrication or on the site or at all or any such places. The CONTRACTOR shall provide assistance, instruments, labour and materials as are |

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normally required for examining, measuring and testing any workmanship as may be selected and required by the ENGINEER-IN-CHARGE.

- 74.2 All the tests that will be necessary in connection with the execution of the WORK as decided by the ENGINEER- IN-CHARGE shall be carried out at the field testing laboratory of the EMPLOYER by paying the charges as decided by the EMPLOYER from time to time. In case of non- availability of testing facility with the EMPLOYER, the required test shall be carried out at the cost of CONTRACTOR at Government or any other testing laboratory as directed by ENGINEER-IN-CHARGE.
- 74.3 If any tests are required to be carried out in conjunction with the WORK or materials or workmanship not supplied by the CONTRACTOR, such tests shall be carried out by the CONTRACTOR as per instructions of ENGINEER-IN-CHARGE and cost of such tests shall be reimbursed by the EMPLOYER.
- 75 Samples for approval:** 75.1 The CONTRACTOR shall furnish to the ENGINEER-IN-CHARGE for approval, when requested or if required by the specifications, adequate samples of all materials and finished to be used in the WORK. Such samples shall be submitted before the WORK is commenced and in ample time to permit tests and examinations thereof. All materials furnished and finishes applied in actual WORK shall be fully equal to the approved samples.
- 76 Action and compensation in case of bad work:** 76.1 If it shall appear to the ENGINEER-IN-CHARGE that any work has been executed with unsound, imperfect or unskilled workmanship, or with materials of any inferior description, or that any materials or articles provided by the CONTRACTOR for the execution of the WORK are unsound, or of a quality inferior to that contracted for, or otherwise not in accordance with the CONTRACT, the CONTRACTOR shall on demand in writing from the ENGINEER-IN-CHARGE or his authorized representative specifying the WORK, materials or articles complained of notwithstanding that the same may have been inadvertently passed, certified and paid for, forthwith rectify or remove and reconstruct the WORK so specified and provide other proper and suitable materials or articles at his own cost and in the event of failure to do so within the period specified by the ENGINEER-IN-CHARGE in his demand aforesaid, the CONTRACTOR shall be liable to pay compensation at the rate of 1% (One percent) of the estimated cost of the whole WORK, for every week limited to a maximum of 10% (ten percent) of the value of the whole WORK, while his failure to do so shall continue and in the case of any such failure the ENGINEER-IN-CHARGE may on expiry of notice period rectify or remove and re-execute the WORK or remove and replaced with others, the materials or articles complained of to as the case may be at the risk and expense in all respects of the CONTRACTOR. The decision of the Engineering-in-charge as to any question arising under this clause shall be final and conclusive.
- 77 Suspension of works:** 77.1 i) Subject to the provisions of sub-para (ii) of this clause, the CONTRACTOR shall, if ordered in writing by the ENGINEER-IN-CHARGE, or his representative, temporarily suspend the WORKS or any part thereof for such written order, proceed with the WORK therein ordered to be suspended until, he shall have received a written order to proceed therewith. The CONTRACTOR shall not be entitled to claim compensation for any loss or damage sustained by him by reason of temporary suspension of the WORKS aforesaid. An extension of time for completion, corresponding with the delay caused by any such suspension of the WORKS as aforesaid will be granted to the CONTRACTOR should he apply for the same provided that the suspension was not consequent to any default or failure on the part of the CONTRACTOR.



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ii) In case of suspensions of entire WORK, ordered in writing by ENGINEER-IN-CHARGE, for a period of more than two months, the CONTRACTOR shall have the option to terminate the CONTRACT.

- 78 Employer may do part of work:** 78.1 Upon failure of the CONTRACTOR to comply with any instructions given in accordance with the provisions of this CONTRACT the EMPLOYER has the alternative right, instead of assuming charge of entire WORK, to place additional labour force, tools, equipments and materials on such parts of the WORK, as the EMPLOYER may designate or also engage another CONTRACTOR to carry out the WORK. In such cases, the EMPLOYER shall deduct from the amount which otherwise might become due to the CONTRACTOR, the cost of such work and material with ten percent (10%) added to cover all departmental charges and should the total amount thereof exceed the amount due to the CONTRACTOR, the CONTRACTOR shall pay the difference to the EMPLOYER.
- 79 Possession prior to completion:** 79.1 The ENGINEER-IN-CHARGE shall have the right to take possession of or use any completed or partially completed WORK or part of the WORK. Such possession or use shall not be deemed to be an acceptance of any work completed in accordance with the CONTRACT agreement. If such prior possession or use by the ENGINEER-IN-CHARGE delays the progress of WORK, equitable adjustment in the time of completion will be made and the CONTRACT agreement shall be deemed to be modified accordingly.
- 80 (Defects liability period) twelve months period of liability from the date of issue of completion certificate:** 80.1 The CONTRACTOR shall guarantee the installation/WORK for a period of 12 months from the date of completion of WORK as certified by the ENGINEER-IN-CHARGE which is indicated in the Completion Certificate. Any damage or defect that may arise or lie undiscovered at the time of issue of Completion Certificate, connected in any way with the equipment or materials supplied by him or in the workmanship, shall be rectified or replaced by the CONTRACTOR at his own expense as deemed necessary by the ENGINEER-IN-CHARGE or in default, the ENGINEER-IN-CHARGE may carry out such works by other work and deduct actual cost incurred towards labour, supervision and materials consumables or otherwise plus 100% towards overheads (of which the certificate of ENGINEER-IN-CHARGE shall be final) from any sums that may then be or at any time thereafter, become due to the CONTRACTOR or from his Contract Performance Security, or the proceeds of sale thereof or a sufficient part on thereof.
- 80.2 If the CONTRACTOR feels that any variation in WORK or in quality of materials or proportions would be beneficial or necessary to fulfil the guarantees called for, he shall bring this to the notice of the ENGINEER-IN-CHARGE in writing.
- If during the period of liability any portion of the WORK/equipment, is found defective and is rectified/ replaced, the period of liability for such equipment/ portion of WORK shall be operative from the date such rectification/ replacement are carried out and Contract Performance Guarantee shall be furnished separately for the extended period of liability for that portion of WORK/ equipment only. Notwithstanding the above provisions the supplier's, guarantees/warranties for the replaced equipment shall also be passed on to the EMPLOYER.
- 80.3 LIMITATION OF LIABILITY
- Notwithstanding anything contrary contained herein, the aggregate total liability of CONTRACTOR under the Agreement or otherwise shall be limited to 100% of Agreement / Contract Value. However, neither party shall be liable to the other party for any indirect and consequential damages, loss of profits or loss of production.
- 81 Care of works:** 81.0 From the commencement to completion of the WORK, the CONTRACTOR shall

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take full responsibility for the care for all works including all temporary works and in case any damages, loss or injury shall happen to the WORK or to any part thereof or to any temporary works from any cause whatsoever, shall at his own cost repair and make good the same so that at completion the WORK shall be in good order and in conformity in every respects with the requirement of the CONTRACT and the ENGINEER-IN-CHARGE's instructions.

81.1 DEFECTS PRIOR TO TAKING OVER:

If at any time, before the WORK is taken over, the ENGINEER-IN-CHARGE shall:

- a) Decide that any works done or materials used by the CONTRACTOR or by any SUB-CONTRACTOR is defective or not in accordance with the CONTRACT, or that the works or any portion thereof are defective, or do not fulfill the requirements of CONTRACT (all such matters being hereinafter, called 'Defects' in this clause), and
- b) As soon as reasonably practicable, gives to the CONTRACTOR notice in writing of the said decision, specifying particulars of the defects alleged to exist or to have occurred, then the CONTRACTOR shall at his own expenses and with all speed make good the defects so specified.

In case CONTRACTOR shall fail to do so, the EMPLOYER may take, at the cost of the CONTRACTOR, such steps as may in all circumstances, be reasonable to make good such defects. The expenditure so incurred by the EMPLOYER will be recovered from the amount due to the CONTRACTOR. The decision of the ENGINEER-IN-CHARGE with regard to the amount to be recovered from the CONTRACTOR will be final and binding on the CONTRACTOR. As soon as the WORK has been completed in accordance with the CONTRACT (except in minor respects that do not affect their use for the purpose for which they are intended and except for maintenance there of provided in clause 80.1 of General Conditions of Contract) and have passed the tests on completion, the ENGINEER-IN-CHARGE shall issue a certificate (hereinafter called Completion Certificate) in which he shall certify the date on which the WORK have been so completed and have passed the said tests and the EMPLOYER shall be deemed to have taken over the WORK on the date so certified. If the WORK has been divided into various groups in the CONTRACT, the EMPLOYER shall be entitled to take over any group or groups before the other or others and there upon the ENGINEER-IN-CHARGE shall issue a Completion Certificate which will, however, be for such group or groups so taken over only. In such an event if the group /section/ part so taken over is related, to the integrated system of the work, not withstanding date of grant of Completion Certificate for group/ section/ part. The period of liability in respect of such group/ section/ part shall extend 12 (twelve) months from the date of completion of WORK.

81.2 DEFECTS AFTER TAKING OVER:

In order that the CONTRACTOR could obtain a COMPLETION CERTIFICATE he shall make good, with all possible speed, any defect arising from the defective materials supplied by the CONTRACTOR or workmanship or any act or omission of the CONTRACT or that may have been noticed or developed, after the works or groups of the works has been taken over, the period allowed for carrying out such WORK will be normally one month. If any defect be not remedied within a reasonable time, the EMPLOYER may proceed to do the WORK at CONTRACTOR's risk and expense and deduct from the final bill such amount as may be decided by the EMPLOYER.

If by reason of any default on the part of the CONTRACTOR a COMPLETION CERTIFICATE has not been issued in respect of any portion of the WORK within



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one month after the date fixed by the CONTRACT for the completion of the WORK, the EMPLOYER shall be at liberty to use the WORK or any portion thereof in respect of which a completion certificate has not been issued, provided that the WORK or the portion thereof so used as aforesaid shall be afforded reasonable opportunity for completing these works for the issue of Completion Certificate.

- 82 Guarantee/transfer of guarantee:** 82.1 For works like water-proofing, acid and alkali resisting materials, pre-construction soil treatment against termite or any other specialized works etc. the CONTRACTOR shall invariably engage SUB-CONTRACTORS who are specialists in the field and firms of repute and such a SUB-CONTRACTOR shall furnish guarantees for their workmanship to the EMPLOYER, through the CONTRACTOR. In case such a SUB-CONTRACTOR/ firm is not prepared to furnish a guarantee to the EMPLOYER, the CONTRACTOR shall give that guarantee to the EMPLOYER directly.
- 83 Training of employer's personnel:** 83.1 The CONTRACTOR undertakes to provide training to Engineering personnel selected and sent by the EMPLOYER at the works of the CONTRACTOR without any cost to the EMPLOYER. The period and the nature of training for the individual personnel shall be agreed upon mutually between the CONTRACTOR and the EMPLOYER. These engineering personnel shall be given special training at the shops, where the equipment will be manufactured and/ or in their collaborator's works and where possible, in any other plant where equipment manufactured by the CONTRACTOR or his collaborators is under installation or test to enable those personnel to become familiar with the equipment being furnished by the CONTRACTOR. EMPLOYER shall bear only the to and fro fare of the said engineering personnel.
- 84 Replacement of defective parts and materials:** 84.1 If during the progress of the WORK, EMPLOYER shall decide and inform in writing to the CONTRACTOR, that the CONTRACTOR has manufactured any plant or part of the plant unsound or imperfect or has furnished plant inferior to the quality specified, the CONTRACTOR on receiving details of such defects or deficiencies shall at his own expenses within 7 (seven) days of his receiving the notice, or otherwise within such time as may be reasonably necessary for making it good, proceed to alter, re-construct or remove such work and furnish fresh equipments up to the standards of the specifications. In case the CONTRACTOR fails to do so, EMPLOYER may on giving the CONTRACTOR 7 (seven) day's notice in writing of his intentions to do so, proceed to remove the portion of the WORK so complained of and at the cost of CONTRACTOR's, perform all such works or furnish all such equipments provided that nothing in the clause shall be deemed to deprive the EMPLOYER of or affect any rights under the CONTRACT, the EMPLOYER may otherwise have in respect of such defects and deficiencies.
- 84.2 The CONTRACTOR's full and extreme liability under this clause shall be satisfied by the payments to the EMPLOYER of the extra cost, of such replacements procured including erection/installation as provided for in the CONTRACT; such extra cost being the ascertained difference between the price paid by the EMPLOYER for such replacements and the CONTRACT price portion for such defective plants and repayments of any sum paid by the EMPLOYER to the CONTRACTOR in respect of such defective plant. Should the EMPLOYER not so replace the defective plant the CONTRACTOR's extreme liability under this clause shall be limited to the repayment of all such sums paid by the EMPLOYER under the CONTRACT for such defective plant.
- 85 Indemnity** 85.1 If any action is brought before a Court, Tribunal or any other Authority against the Employer or an officer or agent of the EMPLOYER, for the failure, omission or neglect on the part of the CONTRACTOR to perform any acts, matters, covenants or things under the CONTRACT, or damage or injury caused by the

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alleged omission or negligence on the part of the CONTRACTOR, his agents, representatives or his SUB- CONTRACTOR's, or in connection with any claim based on lawful demands of SUB-CONTRACTOR's workmen suppliers or employees, the CONTRACTOR, shall in such cases indemnify and keep the EMPLOYER and/or their representatives harmless from all losses, damages, expenses or decrees arising out of such action.

86 Construction aids, equipments, tools & tackles:

86.1 CONTRACTOR shall be solely responsible for making available for executing the WORK, all requisite CONSTRUCTION EQUIPMENTS, Special Aids, Barges, Cranes and the like, all Tools, Tackles and Testing Equipment and Appliances, including imports of such equipment etc. as required. In case of import of the same the rates applicable for levying of Custom Duty on such Equipment, Tools, & Tackles and the duty drawback applicable thereon shall be ascertained by the CONTRACTOR from the concerned authorities of Government of India. It shall be clearly understood that EMPLOYER shall not in any way be responsible for arranging to obtain Custom Clearance and/or payment of any duties and/or duty draw backs etc. for such equipments so imported by the CONTRACTOR and the CONTRACTOR shall be fully responsible for all taxes, duties and documentation with regard to the same. Tenderer in his own interest may contact, for any clarifications in the matter, concerned agencies/Dept./Ministries of Govt. of India. All clarifications so obtained and interpretations thereof shall be solely the responsibility of the CONTRACTOR.

SECTION-VI Certificates and Payments

87 Schedule of rates and payments:

87.1 i) CONTRACTOR'S REMUNERATION:

The price to be paid by the EMPLOYER to CONTRACTOR for the whole of the WORK to be done and for the performance of all the obligations undertaken by the CONTRACTOR under the CONTRACT DOCUMENTS shall be ascertained by the application of the respective Schedule of Rates (the inclusive nature of which is more particularly defined by way of application but not of limitation, with the succeeding sub-clause of this clause) and payment to be made accordingly for the WORK actually executed and approved by the ENGINEER-IN-CHARGE. The sum so ascertained shall (excepting only as and to the extent expressly provided herein) constitute the sole and inclusive remuneration of the CONTRACTOR under the CONTRACT and no further or other payment whatsoever shall be or become due or payable to the CONTRACTOR under the CONTRACT.

ii) SCHEDULE OF RATES TO BE INCLUSIVE:

The prices/rates quoted by the CONTRACTOR shall remain firm till the issue of FINAL CERTIFICATE and shall not be subject to escalation. Schedule of Rates shall be deemed to include and cover all costs, expenses and liabilities of every description and all risks of every kind to be taken in executing, completing and handing over the WORK to the EMPLOYER by the CONTRACTOR. The CONTRACTOR shall be deemed to have known the nature, scope, magnitude and the extent of the WORK and materials required though the CONTRACT DOCUMENT may not fully and precisely furnish them. Tenderer's shall make such provision in the Schedule of Rates as he may consider necessary to cover the cost of such items of WORK and materials as may be reasonable and necessary to complete the WORK. The opinion of the ENGINEER-IN-CHARGE as to the items of WORK which are necessary and reasonable for COMPLETION OF WORK shall be final and binding on the CONTRACTOR, although the same may not be shown on or described specifically in CONTRACT DOCUMENTS.



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Generality of this present provision shall not be deemed to cut down or limit in any way because in certain cases it may and in other cases it may not be expressly stated that the CONTRACTOR shall do or perform a work or supply articles or perform services at his own cost or without addition of payment or without extra charge or words to the same effect or that it may be stated or not stated that the same are included in and covered by the Schedule of Rates.

iii) SCHEDULE OF RATES TO COVER CONSTRUCTION EQUIPMENTS, MATERIALS, LABOUR ETC.:

Without in any way limiting the provisions of the preceding sub-clause the Schedule of Rates shall be deemed to include and cover the cost of all construction equipment, temporary WORK (except as provided for herein), pumps, materials, labour, insurance, fuel, consumables, stores and appliances to be supplied by the CONTRACTOR and all other matters in connection with each item in the Schedule of Rates and the execution of the WORK or any portion thereof finished, complete in every respect and maintained as shown or described in the CONTRACT DOCUMENTS or as may be ordered in writing during the continuance of the CONTRACT.

iv) SCHEDULE OF RATES TO COVER ROYALTIES, RENTS AND CLAIMS:

The Schedule of Rates (i.e., VALUE OF CONTRACT) shall be deemed to include and cover the cost of all royalties and fees for the articles and processes, protected by letters, patent or otherwise incorporated in or used in connection with the WORK, also all royalties, rents and other payments in connection with obtaining materials of whatsoever kind for the WORK and shall include an indemnity to the EMPLOYER which the CONTRACTOR hereby gives against all actions, proceedings, claims, damages, costs and expenses arising from the incorporation in or use on the WORK of any such articles, processes or materials, octroi or other municipal or local Board Charges, if levied on materials, equipment or machineries to be brought to site for use on WORK shall be borne by the CONTRACTOR.



v) SCHEDULE OF RATES TO COVER TAXES AND DUTIES:

No exemption or reduction of Customs Duties, Excise Duties, Sales Tax, Sales Tax on works Contract quay or any port dues, transport charges, stamp duties or Central or State Government or local Body or Municipal Taxes or duties, taxes or charges (from or of any other body), whatsoever, will be granted or obtained, all of which expenses shall be deemed to be included in and covered by the Schedule or Rates. The CONTRACTOR shall also obtain and pay for all permits or other privileges necessary to complete the WORK.

vi) SCHEDULE OF RATES TO COVER RISKS OF DELAY:

The Schedule of Rates shall be deemed to include and cover the risk of all possibilities of delay and interference with the CONTRACTOR's conduct of WORK which occur from any causes including orders of the EMPLOYER in the exercise of his power and on account of extension of time granted due to various reasons and for all other possible or probable causes of delay.

vii) SCHEDULE OF RATES CANNOT BE ALTERED:

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For WORK under unit rate basis, no alteration will be allowed in the Schedule of Rates by reason of works or any part of them being modified, altered, extended, diminished or committed. The Schedule of Rates are fully inclusive of rates which have been fixed by the CONTRACTOR and agreed to by the EMPLOYER and cannot be altered.

For lumpsum CONTRACTS, the payment will be made according to the WORK actually carried out, for which purpose an item wise, or work wise Schedule of Rates shall be furnished, suitable for evaluating the value of WORK done and preparing running account bill. Payment for any additional work which is not covered in the Schedule of Rates, shall only be released on issuance of change order.

88 Procedure for measurement and billing of work in progress:

88.1 BILLING PROCEDURE:

Following procedures shall be adopted for billing of works executed by the CONTRACTOR.

88.1.1 All measurements shall be recorded in sixuplicate on standard measurement sheets supplied by EMPLOYER and submitted to EMPLOYER/CONSULTANT for scrutiny and passing.

88.1.2 EMPLOYER/CONSULTANT shall scrutinize and check the measurements recorded on the sheets and shall certify correctness of the same on the measurement sheets.

88.1.3 ENGINEER-IN-CHARGE shall pass the bills after carrying out the comprehensive checks in accordance with the terms and conditions of the CONTRACTS, within 7 days of submission of the bills, complete in all respects and send the same to the Employer to effect payment to the CONTRACTOR.

88.1.4 TFL shall make all Endeavour to make payments of undisputed amount of the bills submitted based on the joint measurements within 15 (Fifteen) days from the date of certification by the Engineer-in-Charge.

88.1.5 Measurements shall be recorded as per the methods of measurement spelt out in EMPLOYER/CONSULTANT SPECIFICATIONS / CONTRACT DOCUMENT. EMPLOYER/CONSULTANT shall be fully responsible for checking the measurements quantitatively and qualitatively as recorded in the Measurement Books/ Bills.



88.1.6 While preparing the final bills overall measurements will not be taken again. Only volume of work executed since the last measured bill along with summary of final measurements will be considered for the final bill. However, a detailed check shall be made as to missing measurements and in case there are any missing items or measurements the same shall be recorded.

88.2 SECURED ADVANCE ON MATERIAL:

Unless otherwise provided elsewhere in the tender, no 'Secured Advance' on security of materials brought to site for execution of contracted items(s) shall be paid to the Contractor whatsoever.

88.3 DISPUTE IN MODE OF MEASUREMENT:

In case of any dispute as to the mode of measurement not covered by the CONTRACT to be adopted for any item of WORK, mode of measurement as per



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latest Indian Standard Specifications shall be followed.

88.4 ROUNDING OF AMOUNTS:



In calculating the amount of each item due to the CONTRACTOR in every certificate prepared for payment, sum of less than 50 paise shall be omitted and the total amount on each certificate shall be rounded off to the nearest rupees, i.e., sum of less than 50 paise shall be omitted and sums of 50 paise and more upto one rupee shall be reckoned as one rupee.

- 89 Lumpsum in tender:** 89.1 The payment against any Lumpsum item shall be made only on completion of that item as per the provision of the CONTRACT after certification by ENGINEER-IN-CHARGE.
- 90 Running account payments to be regarded as advance:** 90.1 All running account payments shall be regarded as payment by way of advance against the final payment only and not as payments for WORK actually done and completed and shall not preclude the requiring of bad, unsound and imperfect or unskilled work to be removed and taken away and reconstructed or re-erected or be considered as an admission of the due performance of the CONTRACT, or any part thereof, in this respect, or of the accruing of any claim by the CONTRACTOR, nor shall it conclude, determine or affect in any way the powers of the EMPLOYER under these conditions or any of them as to the final settlement and adjustment of the accounts or otherwise, or in any other way vary or affect the CONTRACT. The final bill shall be submitted by the CONTRACTOR within one month of the date of physical completion of the WORK, otherwise, the ENGINEER-IN-CHARGE's certificate of the measurement and of total amount payable for the WORK accordingly shall be final and binding on all parties
- 91 Notice of claims for additional payments:** 91.1 Should the CONTRACTOR consider that he is entitled to any extra payment for any extra/additional WORKS or MATERIAL change in original SPECIFICATIONS carried out by him in respect of WORK he shall forthwith give notice in writing to the ENGINEER-IN-CHARGE that he claims extra payment. Such notice shall be given to the ENGINEER-IN-CHARGE upon which CONTRACTOR bases such claims and such notice shall contain full particulars of the nature of such claim with full details of amount claimed. Irrespective of any provision in the CONTRACT to the contrary, the CONTRACTOR must intimate his intention to lodge claim on the EMPLOYER within 10 (ten) days of the commencement of happening of the event and quantify the claim within 30 (thirty) days, failing which the CONTRACTOR will lose his right to claim any compensation/reimbursement/damages etc. or refer the matter to arbitration. Failure on the part of CONTRACTOR to put forward any claim without the necessary particulars as above within the time above specified shall be an absolute waiver thereof. No omission by EMPLOYER to reject any such claim and no delay in dealing therewith shall be waiver by EMPLOYER of any of this rights in respect thereof.
- 91.2 ENGINEER-IN-CHARGE shall review such claims within a reasonably period of time and cause to discharge these in a manner considered appropriate after due deliberations thereon. However, CONTRACTOR shall be obliged to carry on with the WORK during the period in which his claims are under consideration by the EMPLOYER, irrespective of the outcome of such claims, where additional payments for WORKS considered extra are justifiable in accordance with the CONTRACT provisions, EMPLOYER shall arrange to release the same in the same manner as for normal WORK payments. Such of the extra works so admitted by EMPLOYER shall be governed by all the terms, conditions, stipulations and specifications as are applicable for the CONTRACT. The rates for extra works shall generally be the unit rates provided for in the CONTRACT. In the event unit rates for extra works so executed are not available as per

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CONTRACT, payments may either be released on day work basis for which daily/hourly rates for workmen and hourly rates for equipment rental shall apply, or on the unit rate for WORK executed shall be derived by interpolation/extrapolation of unit rates already existing in the CONTRACT. In all the matters pertaining to applicability of rate and admittance of otherwise of an extra work claim of CONTRACTOR the decision of ENGINEER-IN-CHARGE shall be final and binding.

- 92 Payment of contractor's bill:**
- 92.1 No payment shall be made for works estimated to cost less than Rs.10,000/- till the whole of the work shall have been completed and a certificate of completion given. But in case of works estimated to cost more than Rs.10,000/-, that CONTRACTOR on submitting the bill thereof be entitled to receive a monthly payment proportionate to the part thereof approved and passed by the ENGINEER-IN-CHARGE, whose certificate of such approval and passing of the sum so payable shall be final and conclusive against the CONTRACTOR. This payment will be made after making necessary corrections/deductions as stipulated elsewhere in the CONTRACT DOCUMENT for materials, Contract Performance Security, taxes etc.
- 92.2 Payment due to the CONTRACTOR shall be made by the EMPLOYER by Account Payee cheque forwarding the same to registered office or the notified office of the CONTRACTOR. In no case will EMPLOYER be responsible if the cheque is mislaid or misappropriated by unauthorized person/persons. In all cases, the CONTRACTOR shall present his bill duly pre-receipted on proper revenue stamp payment shall be made in Indian Currency.
- 92.3 In general payment of final bill shall be made to CONTRACTOR within 60 days of the submission of bill on joint measurements, after completion of all the obligations under the CONTRACT.
- 93 Receipt for payment:**
- 93.1 Receipt for payment made on account of work when executed by a firm, must be signed by a person holding due power of attorney in this respect on behalf of the CONTRACTOR, except when the CONTRACTOR's are described in their tender as a limited company in which case the receipts must be signed in the name of the company by one of its principal officers or by some other person having authority to give effectual receipt for the company.
- 94 Completion certificate:**
- 94.1 APPLICATION FOR COMPLETION CERTIFICATE:
- When the CONTRACTOR fulfils his obligation under Clause 81.1 he shall be eligible to apply for COMPLETION CERTIFICATE.
- The ENGINEER-IN-CHARGE shall normally issue to the CONTRACTOR the COMPLETION CERTIFICATE within one month after receiving any application therefore from the CONTRACTOR after verifying from the completion documents and satisfying himself that the WORK has been completed in accordance with and as set out in the construction and erection drawings, and the CONTRACT DOCUMENTS.
- The CONTRACTOR, after obtaining the COMPLETION CERTIFICATE, is eligible to present the final bill for the WORK executed by him under the terms of CONTRACT.
- 94.2 COMPLETION CERTIFICATE:
- Within one month of the completion of the WORK in all respects, the CONTRACTOR shall be furnished with a certificate by the ENGINEER-IN-CHARGE of such completion, but no certificate shall be given nor shall the WORK be deemed to have been executed until all scaffolding, surplus materials and rubbish is cleared off the SITE completely nor until the

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WORK shall have been measured by the ENGINEER-IN-CHARGE whose measurement shall be binding and conclusive. The WORKS will not be considered as complete and taken over by the EMPLOYER, until all the temporary works, labour and staff colonies are cleared to the satisfaction of the ENGINEER-IN-CHARGE.



If the CONTRACTOR fails to comply with the requirements of this clause on or before the date fixed for the completion of the WORK, the ENGINEER-IN-CHARGE may at the expense of the CONTRACTOR remove such scaffolding, surplus materials and rubbish and dispose off the same as he thinks fit and clean off such dirt as aforesaid, and the CONTRACTOR shall forthwith pay the amount of all expenses so incurred and shall have no claim in respect of any such scaffolding or surplus materials as aforesaid except for any sum actually realized by the sale thereof.

94.3 COMPLETION CERTIFICATE DOCUMENTS:

For the purpose of Clause 94.0 the following documents will be deemed to form the completion documents:

- i) The technical documents according to which the WORK was carried out.
- ii) Six (6) sets of construction drawings showing therein the modification and correction made during the course of execution and signed by the ENGINEER-IN-CHARGE.
- iii) COMPLETION CERTIFICATE for 'embedded' and 'covered' up work.
- iv) Certificates of final levels as set out for various works.
- v) Certificates of tests performed for various WORKS.
- vi) Material appropriation, Statement for the materials issued by the EMPLOYER for the WORK and list of surplus materials returned to the EMPLOYER's store duly supported by necessary documents.

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| <p>95 Final decision and final certificate:</p> | <p>95.1</p> | <p>Upon expiry of the period of liability and subject to the ENGINEER-IN-CHARGE being satisfied that the WORKS have been duly maintained by the CONTRACTOR during monsoon or such period as hereinbefore provided in Clause 80 & 81 and that the CONTRACTOR has in all respect duly made-up any subsidence and performed all his obligations under the CONTRACT, the ENGINEER-IN-CHARGE shall (without prejudice to the rights of the EMPLOYER to retain the provisions of relevant Clause hereof) otherwise give a certificate herein referred to as the FINAL CERTIFICATE to that effect and the CONTRACTOR shall not be considered to have fulfilled the whole of his obligations under CONTRACT until FINAL CERTIFICATE shall have been given by the ENGINEER-IN-CHARGE notwithstanding any previous entry upon the WORK and taking possession, working or using of the same or any part thereof by the EMPLOYER.</p> |
| <p>96 Certificate and payments on evidence of completion:</p> | <p>96.1</p> | <p>Except the FINAL CERTIFICATE, no other certificates or payments against a certificate or on general account shall be taken to be an admission by the EMPLOYER of the due performance of the CONTRACT or any part thereof or of occupancy or validity of any claim by the CONTRACTOR.</p> |
| <p>97 Deductions from the contract price:</p> | <p>97.1</p> | <p>All costs, damages or expenses which EMPLOYER may have paid or incurred, which under the provisions of the CONTRACT, the CONTRACTOR is liable/will</p> |

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be liable, will be claimed by the EMPLOYER. All such claims shall be billed by the EMPLOYER to the CONTRACTOR regularly as and when they fall due. Such claims shall be paid by the CONTRACTOR within 15 (fifteen) days of the receipt of the corresponding bills and if not paid by the CONTRACTOR within the said period, the EMPLOYER may, then, deduct the amount from any moneys due i.e., Contract Performance Security or becoming due to the CONTRACTOR under the CONTRACT or may be recovered by actions of law or otherwise, if the CONTRACTOR fails to satisfy the EMPLOYER of such claims.

SECTION-VII Taxes and Insurance

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| 98 Taxes, Duties, Octroi etc: | 98.1 | <p>The CONTRACTOR agrees to and does hereby accept full and exclusive liability for the payment of any and all Taxes, Duties, including Excise duty, octroi etc. now or hereafter imposed, increased, modified, all the sales taxes, duties, octrois etc. now in force and hereafter increased, imposed or modified, from time to time in respect of WORKS and materials and all contributions and taxes for unemployment compensation, insurance and old age pensions or annuities now or hereafter imposed by any Central or State Government authorities which are imposed with respect to or covered by the wages, salaries, or other compensations paid to the persons employed by the CONTRACTOR and the CONTRACTOR shall be responsible for the compliance of all SUB-CONTRACTORS, with all applicable Central, State, Municipal and local law and regulation and requirement of any Central, State or local Government agency or authority. CONTRACTOR further agrees to defend, indemnify and hold EMPLOYER harmless from any liability or penalty which may be imposed by the Central, State or Local authorities by reason or any violation by CONTRACTOR or SUB-CONTRACTOR of such laws, suits or proceedings that may be brought against the EMPLOYER arising under, growing out of, or by reason of the work provided for by this CONTRACT, by third parties, or by Central or State Government authority or any administrative sub-division thereof.</p> <p>Tax deductions will be made as per the rules and regulations in force in accordance with acts prevailing from time to time.</p> |
| 99 Sales tax/turnover tax: | 99.1 | <p>Tenderer should quote all inclusive prices including the liability of Sales Tax/Turnover Tax whether on the works contract as a whole or in respect of bought out components used by the CONTRACTOR in execution of the CONTRACT. EMPLOYER shall not be responsible for any such liability of the CONTRACTOR in respect of this CONTRACT.</p> |
| 100 Statutory variations | 100.1 | <p>Tenderer should quote prices inclusive of excise-duty and sales tax applicable on finished product. Any statutory variations in Excise Duty and sales tax on finished product during the contractual completion period, shall be to the Employer's account for which the Contractor will furnish documentary evidence(s) in support of their claims to TFL. However, any increase in the rate of these taxes and duties (E.D. and S.T.) beyond the contractual completion period shall be to Contractor's account and any decrease shall be passed on to TFL.</p> |
| 101 Insurance: | 101.1 | <p><u>GENERAL</u></p> <p>CONTRACTOR shall at his own expense arrange secure and maintain insurance with reputable insurance companies to the satisfaction of the EMPLOYER as follows:</p> <p>CONTRACTOR at his cost shall arrange, secure and maintain insurance as may be necessary and to its full value for all such amounts to protect the WORKS in progress from time to time and the interest of EMPLOYER against all risks as detailed herein. The form and the limit of such insurance, as defined here in together with the under works thereof in each case should be as acceptable to the</p> |



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EMPLOYER. However, irrespective of work acceptance the responsibility to maintain adequate insurance coverage at all times during the period of CONTRACT shall be that of CONTRACTOR alone. CONTRACTOR's failure in this regard shall not relieve him of any of his responsibilities and obligations under CONTRACT.

Any loss or damage to the equipment, during ocean transportation, port/custom clearance, inland and port handling, inland transportation, storage, erection and commissioning till such time the WORK is taken over by EMPLOYER, shall be to the account of CONTRACTOR. CONTRACTOR shall be responsible for preferring of all claims and make good for the damage or loss by way of repairs and/or replacement of the parts of the Work damaged or lost. CONTRACTOR shall provide the EMPLOYER with a copy of all insurance policies and documents taken out by him in pursuance of the CONTRACT. Such copies of document shall be submitted to the EMPLOYER immediately upon the CONTRACTOR having taken such insurance coverage. CONTRACTOR shall also inform the EMPLOYER at least 60(Sixty) days in advance regarding the expiry cancellation and/or changes in any of such documents and ensure revalidation/renewal etc., as may be necessary well in time.

Statutory clearances, if any, in respect of foreign supply required for the purpose of replacement of equipment lost in transit and/or during erection, shall be made available by the EMPLOYER. CONTRACTOR shall, however, be responsible for obtaining requisite licenses, port clearances and other formalities relating to such import. The risks that are to be covered under the insurance shall include, but not be limited to the loss or damage in handling, transit, theft, pilferage, riot, civil commotion, weather conditions, accidents of all kinds, fire, war risk (during ocean transportation only) etc. The scope of such insurance shall cover the entire value of supplies of equipments, plants and materials to be imported from time to time.

All costs on account of insurance liabilities covered under CONTRACT will be to CONTRACTOR's account and will be included in VALUE OF CONTRACT. However, the EMPLOYER may from time to time, during the currency of the CONTRACT, ask the CONTRACTOR in writing to limit the insurance coverage risk and in such a case, the parties to the CONTRACT will agree for a mutual settlement, for reduction in VALUE OF CONTRACT to the extent of reduced premium amounts.

CONTRACTOR as far as possible shall cover insurance with Indian Insurance Companies, including marine Insurance during ocean transportation.

i) EMPLOYEES STATE INSURANCE ACT:

The CONTRACTOR agrees to and does hereby accept full and exclusive liability for the compliance with all obligations imposed by the Employee State Insurance Act 1948 and the CONTRACTOR further agrees to defend, indemnify and hold EMPLOYER harmless for any liability or penalty which may be imposed by the Central, State or Local authority by reason of any asserted violation by CONTRACTOR or SUB-CONTRACTOR of the Employees' State Insurance Act, 1948, and also from all claims, suits or proceeding that may be brought against the EMPLOYER arising under, growing out of or by reasons of the work provided for by this CONTRACTOR, by third parties or by Central or State Government authority or any political sub- division thereof.

The CONTRACTOR agrees to fill in with the Employee's State Insurance Corporation, the Declaration Forms, and all forms which may be required in respect of the CONTRACTOR's or SUB-CONTRACTOR's employees, who are employed in the WORK provided for or those covered by ESI from time to time under the



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Agreement. The CONTRACTOR shall deduct and secure the agreement of the SUB- CONTRACTOR to deduct the employee's contribution as per the first schedule of the Employee's State Insurance Act from wages and affix the Employees Contribution Card at wages payment intervals. The CONTRACTOR shall remit and secure the agreement of SUB-CONTRACTOR to remit to the State Bank of India, Employee's State Insurance Corporation Account, the Employee's contribution as required by the Act. The CONTRACTOR agrees to maintain all cards and Records as required under the Act in respect of employees and payments and the CONTRACTOR shall secure the agreement of the SUB- CONTRACTOR to maintain such records. Any expenses incurred for the contributions, making contributions or maintaining records shall be to the CONTRACTOR's or SUB-CONTRACTOR's account.

The EMPLOYER shall retain such sum as may be necessary from the total VALUE OF CONTRACT until the CONTRACTOR shall furnish satisfactory proof that all contributions as required by the Employees State Insurance Act, 1948, have been paid. This will be pending on the CONTRACTOR when the ESI Act is extended to the place of work.

ii) WORKMEN COMPENSATION AND EMPLOYER'S LIABILITY INSURANCE:

Insurance shall be effected for all the CONTRACTOR's employees engaged in the performance of this CONTRACT. If any of the work is sublet, the CONTRACTOR shall require the SUB-CONTRACTOR to provide workman's Compensation and employer's liability insurance for the later's employees if such employees are not covered under the CONTRACTOR's Insurance.

iii) ACCIDENT OR INJURY TO WORKMEN:

The EMPLOYER shall not be liable for or in respect of any damages or compensation payable at law in respect or in consequence of any accident or injury to any workman or other person in the Employment of the CONTRACTOR or any SUB-CONTRACTOR save and except an accident or injury resulting from any act or default of the EMPLOYER, his agents or servants and the CONTRACTOR shall indemnify and keep indemnified the EMPLOYER against all such damages and compensation (save and except and aforesaid) and against all claims, demands, proceeding, costs, charges and expenses, whatsoever in respect or in relation thereto.

iv) TRANSIT INSURANCE

In respect of all items to be transported by the CONTRACTOR to the SITE of WORK, the cost of transit insurance should be borne by the CONTRACTOR and the quoted price shall be inclusive of this cost.

v) COMPREHENSIVE AUTOMOBILE INSURANCE

This insurance shall be in such a form as to protect the Contractor against all claims for injuries, disability, disease and death to members of public including EMPLOYER's men and damage to the property of others arising from the use of motor vehicles during on or off the 'site' operations, irrespective of the Employership of such vehicles.



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VI) COMPREHENSIVE GENERAL LIABILITY INSURANCE

- a) This insurance shall protect the Contractor against all claims arising from injuries, disabilities, disease or death of member of public or damage to property of others due to any act or omission on the part of the Contractor, his agents, his employees, his representatives and Sub-Contractor's or from riots, strikes and civil commotion.
- b) Contractor shall take suitable Group Personal Accident Insurance Cover for taking care of injury, damage or any other risks in respect of his Engineers and other Supervisory staff who are not covered under Employees State Insurance Act.
- c) The policy shall cover third party liability. The third party (liability shall cover the loss/ disablement of human life (person not belonging to the Contractor) and also cover the risk of damage to others materials/ equipment/ properties during construction, erection and commissioning at site. The value of third party liability for compensation for loss of human life or partial/full disablement shall be of required statutory value but not less than Rs. 2 lakhs per death, Rs. 1.5 lakhs per full disablement and Rs. 1 lakh per partial disablement and shall nevertheless cover such compensation as may be awarded by Court by Law in India and cover for damage to others equipment/ property as approved by the Purchaser. However, third party risk shall be maximum to Rs. 10(ten) lakhs to death.
- d) The Contractor shall also arrange suitable insurance to cover damage, loss, accidents, risks etc., in respect of all his plant, equipments and machinery, erection tools & tackles and all other temporary attachments brought by him at site to execute the work.
- e) The Contractor shall take out insurance policy in the joint name of EMPLOYER and Contractor from one or more nationalized insurance company from any branch office at Project site.
- f) Any such insurance requirements as are hereby established as the minimum policies and coverage which Contractor must secure and keep in force must be complied with, Contractor shall at all times be free to obtain additional or increased coverage at Contractor's sole expenses.

vii) ANY OTHER INSURANCE REQUIRED UNDER LAW OR REGULATIONS OR BY EMPLOYER:

CONTRACTOR shall also carry and maintain any and all other insurance(s) which he may be required under any law or regulation from time to time without any extra cost to EMPLOYER. He shall also carry and maintain any other insurance which may be required by the EMPLOYER.

102 Damage to Property or to any Person or any Third Party

102.1 i)

CONTRACTOR shall be responsible for making good to the satisfaction of the EMPLOYER any loss or any damage to structures and properties belonging to the EMPLOYER or being executed or procured or being procured by the EMPLOYER or of other agencies within in the premises of all the work of the EMPLOYER, if such loss



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or damage is due to fault and/or the negligence or willful acts or omission of the CONTRACTOR, his employees, agents, representatives or SUB-CONTRACTORS.

- ii) The CONTRACTOR shall take sufficient care in moving his plants, equipments and materials from one place to another so that they do not cause any damage to any person or to the property of the EMPLOYER or any third party including overhead and underground cables and in the event of any damage resulting to the property of the EMPLOYER or of a third party during the movement of the aforesaid plant, equipment or materials the cost of such damages including eventual loss of production, operation or services in any plant or establishment as estimated by the EMPLOYER or ascertained or demanded by the third party shall be borne by the CONTRACTOR. Third party liability risk shall be Rupees One lakh for single accident and limited to Rupees Ten lakhs.
- iii) The CONTRACTOR shall indemnify and keep the EMPLOYER harmless of all claims for damages to property other than EMPLOYER's property arising under or by reason of this agreement, if such claims result from the fault and/or negligence or willful acts or omission of the CONTRACTOR, his employees, agents, representative of SUB-CONTRACTOR.

SECTION-VIII Labour Laws

103 Labour laws:

- 103.1 i) No labour below the age of 18 (eighteen) years shall be employed on the WORK.
- ii) The CONTRACTOR shall not pay less than what is provided under law to labourers engaged by him on the WORK.
- iii) The CONTRACTOR shall at his expense comply with all labour laws and keep the EMPLOYER indemnified in respect thereof.
- iv) The CONTRACTOR shall pay equal wages for men and women in accordance with applicable labour laws.
- v) If the CONTRACTOR is covered under the Contract labour (Regulation and Abolition) Act, he shall obtain a licence from licensing authority (i.e. office of the labour commissioner) by payment of necessary prescribed fee and the deposit, if any, before starting the WORK under the CONTRACT. Such fee/deposit shall be borne by the CONTRACTOR.
- vi) The CONTRACTOR shall employ labour in sufficient numbers either directly or through SUB- CONTRACTOR's to maintain the required rate of progress and of quality to ensure workmanship of the degree specified in the CONTRACT and to the satisfaction of the ENGINEER-IN-CHARGE.
- vii) The CONTRACTOR shall furnish to the ENGINEER-IN- CHARGE the distribution return of the number and description, by trades of the work people employed on the works. The CONTRACTOR shall also submit on the 4th and 19th of every month to the ENGINEER-IN-CHARGE a true statement showing in respect of the second half of the preceding month and the first half of the current month (1) the accidents that occurred during the said fortnight showing the circumstances under which they happened and the extent of damage



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and injury caused by them and (2) the number of female workers who have been allowed Maternity Benefit as provided in the Maternity Benefit Act 1961 on Rules made there under and the amount paid to them.

- viii) The CONTRACTOR shall comply with the provisions of the payment of Wage Act 1936, Employee Provident Fund Act 1952, Minimum Wages Act 1948. Employers Liability Act 1938. Workmen's Compensation Act 1923, Industrial Disputes Act 1947, the Maternity Benefit Act 1961 and Contract Labour Regulation and Abolition Act 1970, Employment of Children Act 1938 or any modifications thereof or any other law relating thereto and rules made there under from time to time.
- ix) The ENGINEER-IN-CHARGE shall on a report having been made by an Inspecting Officer as defined in Contract Labour (Regulation and Abolition) Act 1970 have the power to deduct from the money due to the CONTRACTOR any sum required or estimated to be required for making good the loss suffered by a worker or workers by reason of non-fulfillment of the Conditions of the Contract for the benefit of workers, non-payment of wages or of deductions made from his or their wages which are not justified by the terms of the Contract or non-observance of the said regulations.
- x) The CONTRACTOR shall indemnify the EMPLOYER against any payments to be made under and for the observance of the provisions of the aforesaid Acts without prejudice to his right to obtain indemnity from his SUB-CONTRACTOR's. In the event of the CONTRACTOR committing a default or breach of any of the provisions of the aforesaid Acts as amended from time to time, of furnishing any information or submitting or filling and Form/ Register/ Slip under the provisions of these Acts which is materially incorrect then on the report of the inspecting Officers, the CONTRACTOR shall without prejudice to any other liability pay to the EMPLOYER a sum not exceeding Rs.50.00 as Liquidated Damages for every default, breach or furnishing, making, submitting, filling materially incorrect statement as may be fixed by the ENGINEER-IN- CHARGE and in the event of the CONTRACTOR's default continuing in this respect, the Liquidated Damages may be enhanced to Rs.50.00 per day for each day of default subject to a maximum of one percent of the estimated cost of the WORK put to tender. The ENGINEER-IN-CHARGE shall deduct such amount from bills or Contract Performance Security of the CONTRACTOR and credit the same to the Welfare Fund constitute under these acts. The decision of the ENGINEER-IN-CHARGE in this respect shall be final and binding.

**104 Implementation of
apprentices act, 1961:**



104.1

The CONTRACTOR shall comply with the provisions of the Apprentices Act, 1961 and the Rules and Orders issued there under from time to time. If he fails to do so, his failure will be a breach of the CONTRACT and the ENGINEER-IN-CHARGE may, at his discretion, cancel the CONTRACT. The CONTRACTOR shall also be liable for any pecuniary liability arising on account of any violation by him of the provisions, of the Act.

**105 Contractor to indemnify the
employer:**

105.1 i)

The CONTRACTOR shall indemnify the EMPLOYER and every member, office and employee of the EMPLOYER, also the ENGINEER-IN-CHARGE and his staff against all actions, proceedings, claims, demands, costs and expenses whatsoever arising out of or in connection with the matters referred to in Clause 102.0 and

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elsewhere and all actions, proceedings, claims, demands, costs and expenses which may be made against the EMPLOYER for or in respect of or arising out of any failure by the CONTRACTOR in the performance of his obligations under the CONTRACT DOCUMENT. The EMPLOYER shall not be liable for or in respect of or arising out of any failure by the CONTRACTOR in the performance of his obligations under the CONTRACT DOCUMENT. The EMPLOYER shall not be liable for or in respect of any demand or compensation payable by law in respect or in consequence of any accident or injury to any workmen or other person. In the employment of the CONTRACTOR or his SUB-CONTRACTOR the CONTRACTOR shall indemnify and keep indemnified the EMPLOYER against all such damages and compensations and against all claims, damages, proceedings, costs, charges and expenses whatsoever in respect thereof or in relation thereto.

ii) **PAYMENT OF CLAIMS AND DAMAGES:**

Should the EMPLOYER have to pay any money in respect of such claims or demands as aforesaid the amount so paid and the costs incurred by the EMPLOYER shall be charged to and paid by the CONTRACTOR and the CONTRACTOR shall not be at liberty to dispute or question the right of the EMPLOYER to make such payments notwithstanding the same, may have been made without the consent or authority or in law or otherwise to the contrary.

iii) In every case in which by virtue of the provisions of Section 12, Sub-section (i) of workmen's compensation Act, 1923 or other applicable provision of Workmen Compensation Act or any other Act, the EMPLOYER is obliged to pay compensation to a workman employed by the CONTRACTOR in execution of the WORK, the EMPLOYER will recover from the CONTRACTOR the amount of the compensation so paid, and without prejudice to the rights of EMPLOYER under Section 12, Sub- section (2) of the said act, EMPLOYER shall be at liberty to recover such amount or any part thereof by deducting it from the Contract Performance Security or from any sum due to the CONTRACTOR whether under this CONTRACT or otherwise. The EMPLOYER shall not be bound to contest any claim made under Section 12, Sub-section (i) of the said act, except on the written request of the CONTRACTOR and upon his giving to the EMPLOYER full security for all costs for which the EMPLOYER might become liable in consequence of contesting such claim.

106 Health and sanitary arrangements for workers:



106.1 In respect of all labour directly or indirectly employed in the WORKS for the performance of the CONTRACTOR's part of this agreement, the CONTRACTOR shall comply with or cause to be complied with all the rules and regulations of the local sanitary and other authorities or as framed by the EMPLOYER from time to time for the protection of health and sanitary arrangements for all workers.

106.2 The CONTRACTOR shall provide in the labour colony all amenities such as electricity, water and other sanitary and health arrangements. The CONTRACTOR shall also provide necessary surface transportation to the place of work and back to the colony for their personnel accommodated in the labour colony.

SECTION-IX Applicable Laws and Settlement of Disputes

107 Arbitration:

107.1 Unless otherwise specified, the matters where decision of the Engineer-in-Charge is deemed to be final and binding as provided in the Agreement and the

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issues/disputes which cannot be mutually resolved within a reasonable time, all disputes shall be referred to arbitration by Sole Arbitrator.

The Employer [Talcher Fertilizers Ltd.] shall suggest a panel of three independent and distinguished persons to the bidder/contractor/supplier/buyer (as the case may be) to select any one among them to act as the Sole Arbitrator.

In the event of failure of the other parties to select the Sole Arbitrator within 30 days from the receipt of the communication suggesting the panel of arbitrators, the right of selection of the sole arbitrator by the other party shall stand forfeited and the EMPLOYER (TFL) shall have discretion to proceed with the appointment of the Sole Arbitrator. The decision of Employer on the appointment of the sole arbitrator shall be final and binding on the parties.

The award of sole arbitrator shall be final and binding on the parties and unless directed/awarded otherwise by the sole arbitrator, the cost of arbitration proceedings shall be shared equally by the parties. The Arbitration proceedings shall be in English language and venue shall be New Delhi, India.

Subject to the above, the provisions of (Indian) Arbitration & Conciliation ACT 1996 and the Rules framed there under shall be applicable. All matter relating to this contract are subject to the exclusive jurisdiction of the court situated in the state of Delhi.



Bidders/suppliers/contractors may please note that the Arbitration & Conciliation Act 1996 was enacted by the Indian Parliament and is based on United Nations Commission on International Trade Law (UNCITRAL model law), which were prepared after extensive consultation with Arbitral Institutions and centers of International Commercial Arbitration. The United Nations General Assembly vide resolution 31/98 adopted the UNCITRAL Arbitration rules on 15 December 1976.

107.2 FOR THE SETTLEMENT OF DISPUTES BETWEEN GOVERNMENT DEPARTMENT AND ANOTHER AND ONE GOVERNMENT DEPARTMENT AND PUBLIC ENTERPRISE AND ONE PUBLIC ENTERPRISE AND ANOTHER THE ARBITRATION SHALL BE AS FOLLOWS:

"In the event of any dispute or difference between the parties hereto, such dispute or difference shall be resolved amicably by mutual consultation or through the good offices of empowered agencies of the Government. If such resolution is not possible, then, the unresolved dispute or difference shall be referred to arbitration of an arbitrator to be nominated by Secretary, Department of Legal Affairs ("Law Secretary") in terms of the Office Memorandum No.55/3/1/75-CF, dated the 19th December 1975 issued by the Cabinet Secretariat (Department of Cabinet Affairs), as modified from time to time. The Arbitration Act 1940 (10 of 1940) shall not be applicable to the arbitration under this clause. The award of the Arbitrator shall be binding upon parties to the dispute. Provided, however, any party aggrieved by such award may make a further reference for setting aside or revision of the award to Law Secretary whose decision shall bind the parties finally and conclusively.

108 Jurisdiction:

The CONTRACT shall be governed by and constructed according to the laws in force in INDIA. The CONTRACTOR hereby submits to the jurisdiction of the Courts situated at DELHI for the purposes of disputes, actions and proceedings arising out of the CONTRACT, the courts at DELHI only will have the jurisdiction to hear and decide such disputed, actions and proceedings.

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SECTION-X Safety Codes

- 109 General:** 109.1 CONTRACTOR shall adhere to safe construction practice and guard against hazardous, and unsafe working conditions and shall comply with EMPLOYER's safety rules as set forth herein. Prior to start of construction, CONTRACTOR will be furnished copies of EMPLOYER's "Safety Code" for information and guidance, if it has been prepared.
- 110 Safety regulations:** 110.1
- i) In respect of all labour, directly employed in the WORK for the performance of CONTRACTOR's part of this agreement, the CONTRACTOR shall at his own expense arrange for all the safety provisions as per safety codes of C.P.W.D., Indian Standards Institution. The Electricity Act, The Mines Act and such other acts as applicable.
- ii) The CONTRACTOR shall observe and abide by all fire and safety regulations of the EMPLOYER. Before starting construction work CONTRACTOR shall consult with EMPLOYER's safety Engineers or ENGINEER- IN-CHARGE and must make good to the satisfaction of the EMPLOYER any loss or damage due to fire to any portion of the work done or to be done under this agreement or to any of the EMPLOYER's existing property.
- 111 First aid and industrial injuries:** 111.0
- i) CONTRACTOR shall maintain first aid facilities for its employees and those of its SUB-CONTRACTOR.
- ii) CONTRACTOR shall make outside arrangements for ambulance service and for the treatment of industrial injuries. Names of those providing these services shall be furnished to EMPLOYER prior to start of construction and their telephone numbers shall be prominently posted in CONTRACTOR's field office.
- iii) All critical industrial injuries shall be reported promptly to EMPLOYER, and a copy of CONTRACTOR's report covering each personal injury requiring the attention of a physician shall be furnished to the EMPLOYER.
- 112 General rules:** 112.0 Smoking within the battery area, tank farm or dock limits is strictly prohibited. Violators of the no smoking rules shall be discharged immediately.
- 113 Contractor's barricades:.** 113.0
- i) CONTRACTOR shall erect and maintain barricades required in connection with his operation to guard or protect:-
- a) Excavations
- b) Hoisting Areas.
- c) Areas adjudged hazardous by CONTRACTOR's or EMPLOYER's inspectors.
- d) EMPLOYER's existing property subject to damage by CONTRACTOR's Operations.
- e) Rail Road unloading spots.
- ii) CONTRACTOR's employees and those of his SUB-CONTRACTOR's shall become acquainted with EMPLOYER's barricading practice and shall respect the provisions thereof.



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iii) Barricades and hazardous areas adjacent to, but not located in normal routes of travel shall be marked by red flasher lanterns at nights.

114 Scaffolding:

114.1 i)

Suitable scaffolding should be provided for workmen for all works that cannot safely be done from the ground or from solid construction except such short period work as can be done safely from ladders. When a ladder is used an extra Mazdoor shall be engaged for holding the ladder and if the ladder is used for carrying material as well, suitable footholds and handholds shall be provided on the ladder and the ladder shall be given an inclination not steeper than 1 in 4 (1 horizontal and 4 vertical).

ii)

Scaffolding or staging more than 4 metres above the ground or floor, swing suspended from an overhead support or erected with stationary support shall have a guard rail properly attached, bolted, braced and otherwise retarded at least one metre high above the floor or platform of such scaffolding or staging and extending along the entire length of the outside and ends thereof with only such openings as may be necessary for the delivery of materials. Such scaffolding or staging shall be so fastened as to prevent it from swaying from the building or structure.

iii)

Working platform, gangway and stairway should be so constructed that they should not sag unduly or unequally and if the height of platform of the gangway or the stairway is more than 4 metres above the ground level or floor level, they should be closely boarded, should have adequate width and should be suitably fastened as in ii) above.

iv)

Every opening in the floor of a building or in a working platform shall be provided with suitable means to prevent the fall of persons or materials by providing suitable fencing or railing whose minimum heights shall be 1 metre.

v)



Safe-means of access shall be provided to all working platforms and other working places, every ladder shall be securely fixed. No portable single ladder shall be over 9 metres in length while the width between side rails in rung ladder shall in no case be less than 30 cms for ladder upto and including 3 metres in length. For longer ladder this width should be increased 5mm for each additional foot of length. Uniform steps spacing shall not exceed 30 cms. Adequate precautions shall be taken to prevent danger from electrical equipment. No materials on any of the sites or work shall be so stacked or placed to cause danger or inconvenience to any person or public. The CONTRACTOR shall also provide all necessary fencing and lights to protect the workers and staff from accidents, and shall be bound to bear the expenses of defense of every suit, action or other proceeding of law that may be brought by any person for injury sustained owing to neglect of the above precautions and pay any damages and costs which may be awarded in any such suit or action or proceeding to any such person or which may with the consent of the CONTRACTOR be paid to compromise any claim by any such person.

115 Excavation and trenching:

115.1

All trenches 1.2 metres or more in depth, shall at all times be supplied with at least one ladder for each 50 metres length or fraction thereof.

Ladder shall be extended from bottom of the trenches to atleast 1 metre above the surface of the ground. The sides of the trenches which are 1.5M in depth shall be stepped back to give suitable slope or securely held by timber bracing, so as to avoid the danger of sides to collapse. The excavated materials shall not be placed within 1.5 metres of the edge of the trench or half of the trench width whichever is more. Cutting shall be done from top to bottom. Under no circumstances

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undermining or under-cutting shall be done.

- 116 Demolition/general safety:** 116.1
- i) Before any demolition work is commenced and also during the progress of the demolition work
 - a) All roads and open areas adjacent to the work site shall either be closed or suitably protected.
 - b) No electric cable or apparatus which is liable to be a source of danger shall remain electrically charged.
 - c) All practical steps shall be taken to prevent danger to persons employed from risk of fire or explosion or flooding. No floor, roof or other part of the building shall be so overloaded with debris or materials as to render it unsafe.
 - ii) All necessary personal safety equipment as considered adequate by the ENGINEER-IN-CHARGE, should be kept available for the use of the persons employed on the SITE and maintained in condition suitable for immediate use, and the CONTRACTOR shall take adequate steps to ensure proper use of equipment by those concerned.
 - a) Workers employed on mixing asphaltic materials, cement and lime mortars shall be provided with protective footwear and protective gloves.
 - b) Those engaged in white washing and mixing or stacking or cement bags or any material which are injurious to the eyes be provided with protective goggles.
 - c) Those engaged in welding and cutting works shall be provided with protective face & eye shield, hand gloves, etc.
 - d) Stone breakers shall be provided with protective goggles and protective clothing and seated at sufficiently safe intervals.
 - e) When workers are employed in sewers and manholes, which are in use, the CONTRACTOR shall ensure that the manhole covers are opened and are ventilated atleast for an hour before the workers are allowed to get into the manholes, and the manholes so opened shall be cordoned off with suitable railing and provided with warning signals or board to prevent accident to the public.
 - f) The CONTRACTOR shall not employ men below the age of 18 years and women on the work of painting with products containing lead in any form. Wherever men above the age of 18 years are employed on the work of lead painting, the following precautions should be taken.
 - 1) No paint containing lead or lead product shall be used except in the form of paste or readymade paint.
 - 2) Suitable face masks should be supplied for use by the workers when paint is applied in the form of spray or a surface having lead paint dry rubbed and scrapped.
 - 3) Overalls shall be supplied by the CONTRACTOR to



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the workmen and adequate facilities shall be provided to enable the working painters to wash them during and on cessation of work.

- iii) When the work is done near any place where there is risk of drowning, all necessary safety equipment should be provided and kept ready for use and all necessary steps taken for prompt rescue of any person in danger and adequate provision should be made for prompt first aid treatment of all injuries likely to be sustained during the course of the work.
- iv) Use of hoisting machines and tackles including their attachments, anchorage and supports shall conform to the following standards or conditions:
- a) These shall be of good mechanical construction, sound materials and adequate strength and free from patent defect and shall be kept in good working order.
- b) Every rope used in hoisting or lowering materials or as means of suspension shall be of durable quality and adequate strength and free from patent defects.
- c) Every crane driver or hoisting appliance operator shall be properly qualified and no person under the age of 21 years should be in charge of any hoisting machine including any scaffolding, winch or give signals to the operator.
- d) In case of every hoisting machine and of every chain ring hook, shackle, swivel, and pulley block used in hoisting or lowering or as means of suspension, the safe working load shall be ascertained by adequate means. Every hoisting machine and all gears referred to above shall be plainly marked with the safe working load of the conditions under which it is applicable and the same shall be clearly indicated. No part of any machine or any gear referred to above in this paragraph shall be loaded beyond safe working load except for the purpose of testing.
- e) In case of departmental machine, the safe working load shall be notified by the ENGINEER- IN-CHARGE. As regards CONTRACTOR's machines, the CONTRACTOR shall notify the safe working load of the machine to the ENGINEER-IN-CHARGE whenever he brings any machinery to SITE of WORK and get it verified by the Engineer concerned.
- v) Motors, gears, transmission lines, electric wiring and other dangerous parts of hoisting appliances should be provided with efficient safeguards. Hoisting appliances should be provided with such means as to reduce to minimum the accidental descent of the load, adequate precautions should be taken to reduce the minimum risk of any part or parts of a suspended load becoming accidentally displaced. When workers are employed on electrical installations which are already energized, insulating mats, wearing apparel, such as gloves, sleeves, and boots as may be necessary should be provided. The workers shall not wear any rings, watches and carry keys or other materials which are good conductors of electricity.
- vi) All scaffolds, ladders and other safety devices mentioned or described herein shall be maintained in safe conditions and no scaffolds, ladder or



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equipment shall be altered or removed while it is in use. Adequate washing facilities should be provided at or near places of work.

- vii) These safety provisions should be brought to the notice of all concerned by displaying on a notice board at a prominent place at the work-spot. The person responsible for compliance of the safety code shall be named therein by the CONTRACTOR.
- viii) To ensure effective enforcement of the rules and regulations relating to safety precautions, the arrangements made by the CONTRACTOR shall be open to inspection by the Welfare Officer, ENGINEER-IN-CHARGE or safety Engineer of the Administration or their representatives.
- ix) Notwithstanding the above clauses there is nothing in these to exempt the CONTRACTOR for the operations of any other Act or rules in force in the Republic of India. The work throughout including any temporary works shall be carried out in such a manner as not to interfere in any way whatsoever with the traffic on any roads or footpath at the site or in the vicinity thereto or any existing works whether the property of the Administration or of a third party.

In addition to the above, the CONTRACTOR shall abide by the safety code provision as per C.P.W.D. Safety code and Indian Standard Safety Code from time to time.

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| 117 Care in handling inflammable gas: | 117.1 | The CONTRACTOR has to ensure all precautionary measures and exercise utmost care in handling the inflammable gas cylinder/inflammable liquids/paints etc. as required under the law and/or as advised by the fire Authorities of the EMPLOYER |
| 118 Temporary combustible structures: | 118.1 | Temporary combustible structures will not be built near or around work site. |
| 119 Precautions against fire: | 119.1 | The CONTRACTOR will have to provide Fire Extinguishers, Fire Buckets and drums at worksite as recommended by ENGINEER-IN-CHARGE. They will have to ensure all precautionary measures and exercise utmost care in handling the inflammable gas cylinders/ inflammable liquid/ paints etc. as advised by ENGINEER-IN-CHARGE. Temporary combustible structures will not be built near or around the work-site. |
| 120 Explosives: | 120.1 | Explosives shall not be stored or used on the WORK or on the SITE by the CONTRACTOR without the permission of the ENGINEER-IN-CHARGE in writing and then only in the manner and to the extent to which such permission is given. When explosives are required for the WORK they will be stored in a special magazine to be provided at the cost of the CONTRACTOR in accordance with the Explosives Rules. The CONTRACTOR shall obtain the necessary licence for the storage and the use of explosives and all operations in which or for which explosives are employed shall be at sole risk and responsibility of the CONTRACTOR and the CONTRACTOR shall indemnify the EMPLOYER against any loss or damage resulting directly or indirectly therefrom. |
| 121 Mines act: | 121.1 | SAFETY CODE: The CONTRACTOR shall at his own expense arrange for the safety provisions as required by the ENGINEER-IN-CHARGE in respect of all labour directly employed for performance of the WORKS and shall provide all facilities in connection therewith. In case the CONTRACTOR fails to make arrangements and provides necessary facilities as aforesaid, the ENGINEER-IN- |

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CHARGE shall be entitled to do so and recover the costs thereof from the CONTRACTOR.



121.2 Failure to comply with Safety Code or the provisions relating to report on accidents and to grant of maternity benefits to female workers shall make the CONTRACTOR liable to pay Company Liquidated Damages an amount not exceeding Rs.50/- for each default or materially incorrect statement. The decision of the ENGINEER-IN-CHARGE in such matters based on reports from the Inspecting Officer or from representatives of ENGINEER-IN-CHARGE shall be final and binding and deductions for recovery of such Liquidated Damages may be made from any amount payable to the CONTRACTOR from all the provisions of the Mines Act, 1952 or any statutory modifications or re-enactment thereof the time being in force and any Rules and Regulations made there under in respect of all the persons employed by him under this CONTRACT and shall indemnify the EMPLOYER from and against any claim under the Mines Act or the rules and regulations framed there under by or on behalf of any persons employed by him or otherwise.

122 Preservation of place: 122.1 The CONTRACTOR shall take requisite precautions and use his best endeavors to prevent any riotous or unlawful behavior by or amongst his worker and others employed or the works and for the preservation of peace and protection of the inhabitants and security of property in the neighborhood of the WORK. In the event of the EMPLOYER requiring the maintenance of a Special Police Force at or in the vicinity of the site during the tenure of works, the expenses thereof shall be borne by the CONTRACTOR and if paid by the EMPLOYER shall be recoverable from the CONTRACTOR.

123 Outbreak of infectious diseases: 123.1 The CONTRACTOR shall remove from his camp such labour and their facilities who refuse protective inoculation and vaccination when called upon to do so by the ENGINEER-IN-CHARGE's representative. Should Cholera, Plague or other infectious diseases break out the CONTRACTOR shall burn the huts, beddings, clothes and other belongings or used by the infected parties and promptly erect new huts on healthy sites as required by the ENGINEER-IN-CHARGE failing which within the time specified in the Engineer's requisition, the work may be done by the EMPLOYER and the cost thereof recovered from the CONTRACTOR.

124 Use of intoxicants: 124.1 The unauthorized sale of spirits or other intoxicants, beverages upon the work in any of the buildings, encampments or tenements owned, occupied by or within the control of the CONTRACTOR or any of his employee is forbidden and the CONTRACTOR shall exercise his influence and authority to the utmost extent to secure strict compliance with this condition.

In addition to the above, the CONTRACTOR shall abide by the safety code provision as per C.P.W.D. safety code and Indian Standard Code framed from time to time.

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SECTION-V

SPECIAL CONDITIONS OF CONTRACT



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1.0 INTRODUCTION:

1.1. Talcher Fertilizers Ltd. (TFL), hereinafter also referred to as “OWNER”, A joint venture company of four major Public Sector Units – M/s. Gas Authority India Limited (GAIL), M/s. Rastriya Chemicals & Fertilizers Ltd. (RCF), M/s. Coal India Ltd. (CIL) and M/s. Fertilizers Corporation of India Ltd. (FCIL) has decided to build a world class Coal based fertilizer complex. The fertilizer complex is to be built at **Talcher, Angul District, Odisha (India)** and will consist of Coal Gasification Plant, Ammonia Plant and Urea Plant, along with Offsite and Utility Plants. Talcher Fertilizers Ltd. intend to invite quotations from eligible Contractors for Construction of 220 kV LILO GIS AT TALCHER FERTILIZERS LTD., ANGUL, ODISHA

Further, it may also be noted that the 220kV GIS Substation along with associated 220kV LILO Line shall be handed over to OPTCL after successful commissioning.

1.2 Projects & Development India Ltd. (PDIL) has been retained as Consultant for providing Engineering Consultancy Services and Project Management Services for the aforesaid project.

1.3 **Brief Scope of Work:** The 220kV GIS Switching Substation would essentially consist Construction of 220kV Switching Substation with indoor type 220kV SF6 Gas Insulated Switchgear (GIS), 33kV outdoor AIS Switchgear, 1x20 MVA 220/33kV Power Transformer, 220kV Bus Duct, 2x250 kVA 33/0.415 kV Station Transformer, Control & Relay Panels, LT Panels, 220V & 48V DC System, Earthing System, Lightning Protection, Fire Detection & Alarm System, DG Set, AC & Ventilation, Metering, Protection, communication & Automation etc. along with all allied Civil, Structural, Mechanical & Electrical Work. The successful Bidder / Agency shall consider all the equipment, material & construction practice.

To meet the above requirement the contractor shall carry out the Design, detailed Engineering, manufacturing/Procurement, Supply, Fabrication, Third Party Inspection (TPI) as applicable, Expediting, Site Survey and Condition Assessment, Insurance, Transportation of all Equipment / Materials to Work Site, Storage & Materials Management, Construction and Erection of all Civil, Mechanical, Electrical and Instrumentation Works, Assembly and Installation of Equipment's, Obtaining all necessary approvals from M/S OPTCL, Testing, Pre-Commissioning, Commissioning, and Handing Over of “220kV GIS Switching Substation” to OPTCL under Single Point Responsibility basis at Talcher, Angul district, Odisha for Talcher Fertilizers Limited.

2.0 LOCATION OF THE PROJECT SITE

A brief description of infrastructure at Talcher Fertilizer Plant Site is furnished below:



- The proposed project will be located within the premises of existing closed coal based Ammonia-Urea complex of FCI Ltd. Talcher Unit.

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- The total land area of the site is 904.53 acres out of which lease hold land from Government of Odisha is 894.207 acres and land purchased from private parties is 10.33 acres.
- The area is not falling under coal bearing zone up to a depth of 200-250 meter.
- Talcher site is located at Vikrampur in Angul district of Odisha on the Cuttack-Sambalpur National Highway NH-42. NH-42 is passing at about 8 km from the site. The nearest railway station is Talcher at about 7 km from the site. Nearest air port Bhubaneswar is 150 km, 3 hours journey by road/ rail. Nearest sea port is Paradeep, 200 km by rail/road from the site. Talcher is situated at 21° 10" N Latitude and 82° 5" E Longitude.

3.0 GENERAL

- 3.1 Special Conditions of Contract shall be read in Conjunction with the General conditions of Contract, specification of work, Drawings and any other documents forming part of this Contract wherever the context so requires.
- 3.2 Notwithstanding the sub-division of the documents into these separate sections and volumes, every part of each shall be deemed to be supplementary to and complementary of every other part and shall be read with and into the Contract so far as it may be practicable to do so.
- 3.3 Where any portion of the General Condition of Contract is repugnant to or at variance with any provisions of the Special Conditions of Contract, unless a different intention appears, the provisions of the Special Conditions of Contract shall be deemed to override the provisions of the General Conditions of Contract and shall to the extent of such repugnancy, or variations, prevail.
- 3.4 Wherever it is mentioned in the specifications that the Contractor shall perform certain work or provide certain facilities, it is understood that the Contractor shall do so at his cost and the value of contract shall be deemed to have included cost of such performance and provisions, so mentioned.
- 3.5 The materials, design, and workmanship shall satisfy the relevant Indian Standards and CPWD specifications, the Job Specifications contained herein and Codes referred to. Where the job specification stipulate requirements in addition to those contained in the standard codes and specifications, these additional requirements shall also be satisfied.
- 3.6 It will be the Contractor's responsibility to bring to the notice of Engineer-in-Charge any irreconcilable conflict in the contract documents before starting the work (s) or making the supply with reference which the conflict exists.
- 3.7 In the absence of any Specifications covering any material, design of work (s) the same shall be performed / supplies / executed in accordance with Standard Engineering Practice as per the instructions / directions of the Engineer-in-Charge, which will be binding on the Contractor.
- 3.8 'Codes' shall mean the following including the latest amendments and/or replacements, if any:

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- i) Indian Electricity Act, 2003 and Rules and Regulations made thereunder.
- ii) Indian Factory Act, 1948 and Rules and Regulations made thereunder.
- iii) Indian Explosives Act, 1884 and Rules and Regulations made thereunder.
- iv) Indian Petroleum Act, 1934 and Rules and Regulations made thereunder.
- v) A.S.M.E. Test Codes.
- vi) A.I.E.E. Test Codes
- vii) American Society of Materials Testing Codes.
- viii) Standards of the Bureau of Indian Standards (BIS).
- ix) Other Internationally approved standards and/or rules and regulations touching the subject matter of the Contract.
- x) OPWD Code with its latest amendments.

3.9 All the spares for the equipment under the contract will strictly conform to the specification and documents and will be identical to the corresponding main equipment / components supplied under the contract and shall be fully interchangeable.

All the mandatory spares covered under the contract shall be supplied along with the main equipment and the delivery would be completed by the respective dates for the various categories of equipment as per the agreed Work Completion Schedule.



4.0 GENERAL PROVISION WITH REGARD TO MATERIALS

4.1 The CONTRACTOR shall, within the scope of work, undertake the following activities and responsibilities with respect to and in addition and without prejudice to the activities and responsibilities under Clause 4.1 and associated clauses there under in respect of materials:

- i) The CONTRACTOR shall in taking delivery, ensure compliance of any condition for delivery applicable to deliveries from the concerned authority or carrier, and shall be exclusively responsible to pay and bear any detention, demurrage or penalty or other charges payable by virtue of any delay or failure by the CONTRACTOR in lifting the materials or in observing any of the conditions aforesaid, and shall keep the OWNER indemnified from and against all consequences there of
- ii) The CONTRACTOR shall maintain a day-to-day account of all materials indicating the daily receipt(s), consumption(s) and balance of each material and category thereof. Such account shall be in the format, if any, prescribed by the ENGINEER-IN-CHARGE and shall be supported by all documents necessary to verify the correctness of the entries in the account. Such account shall be maintained at the CONTRACTOR MANAGER's office and site(s) and shall be open for inspection and verification (by verification of documents in support of the entry as also by feasible verification of the stock) at all times by the ENGINEER-IN-CHARGE with authority at all times without obstruction to enter into or upon any godown or other place(s) or premise(s) where the materials or any part of them are lying or stored and to inspect the same himself and or through his representative(s).

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- iii) All materials shall be taken delivery of, held, stored and utilised by the CONTRACTOR as Trustee of the OWNER, and delivery of the material to the CONTRACTOR shall constitute an entrustment thereof to the CONTRACTOR, with the intent that any utilization, application or disposal thereof by the CONTRACTOR otherwise than for permanent incorporation in the contractual works in terms of the contract shall constitute a breach of trust by the CONTRACTOR.
- iv) The CONTRACTOR shall at all times be exclusively responsible for any and all losses, damages, deterioration, misuse, wastage, theft, or other application or misapplication or disposal of the materials or any of them contrary to the provisions hereof and shall keep the OWNER indemnified from and against the same and shall forthwith at its own cost and expenses replace any such material, lost, damaged, deteriorated, misused, wasted, stolen, applied, misapplied and/or disposed as aforesaid with other material of equivalent quality and quantity delivered to site at the CONTRACTOR's risks and costs in all respects.
- v) The CONTRACTOR shall take out, at his own cost and keep in force at all times, during transit, handling, storage, and erection upto completion in all respect of the work, policy (ies) with Insurance Company (ies) approved by the OWNER for the full replacement value of the materials at site against the risks specified in the CONTRACT. Such policies shall be in the joint names of the OWNER and the CONTRACTOR, with exclusive right in the OWNER to receive all monies due in respect of such policy (ies) and with right in the OWNER (but without obligation to do so) to take out and pay the premia for any such policy (ies) and deduct the premia and any other costs and expense in this behalf from the monies for the time being due or in future becoming due to the CONTRACTOR. In case of Insurance claim, the GST leviable on the transfer of the claim money from OWNER to CONTRACTOR shall be over and above the GST cap indicated in the CONTRACT and shall be borne by OWNER.
- vi) If the CONTRACTOR shall default in replacing at the job SITE, without any additional cost to the OWNER, any material lost, damaged, deteriorated, misused, wasted, short, stolen, misapplied or disposed of within the provisions hereof above, the CONTRACTOR shall be liable to pay to the OWNER the cost of such materials.
- a) Notwithstanding anything herein provided, the CONTRACTOR shall be and remain solely and exclusively liable to repair, restore or replace, as the case may be, the materials damaged or destroyed as a result of any act or omission, notwithstanding the existence or otherwise of any policy(ies) of insurance aforesaid, with the intent that any policy(ies) of insurance aforesaid taken out by the CONTRACTOR or by the OWNER, on default by the CONTRACTOR, shall not anyway absolve the CONTRACTOR from his full liability up to and until issue of the Preliminary Acceptance Certificate as provided for herein in respect of the works, the work(s) and all materials incorporated therein shall be and remain at the risks of the CONTRACTOR in all respects, including (but not limited to) accident, lightning, earth-quake, fire, storm, flood, tempest, riot, civil commotion and/or war or otherwise with respect to the materials, but shall constitute merely an additional security and not a substitution of liability.

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- b) It shall be the exclusive responsibility of the CONTRACTOR to lodge and pursue any or all claims in respect of the insurance aforesaid.
- c) The CONTRACTOR shall, as a condition to the certification of any Running Account Bill, satisfy the OWNER/ Engineer-In-Charge of the existence of one or more policy(ies) of insurance, covering the materials as specified herein. The policy(ies) of insurance aforesaid shall cover all insurable risks, including but not limited to, any loss or damage commencing from the supplier's ware house in handling, transit, storage and during erection, theft, pilferage, riot, civil commotion, force majeure (including earth quake, flood, storm, cyclone, tidal wave, lightening and other adverse weather conditions), accidents of kinds, fire, war risks and explosion.
- vii) If the CONTRACTOR shall default in replacing at the job site, free of any cost to the OWNER, any material lost, damaged, deteriorated, misused, wasted, short, stolen, misapplied or disposed of within the provisions hereof above, the CONTRACTOR shall be liable to pay to the OWNER the cost of such materials.

4.2 SUPPLY OF MATERIALS

- 4.2.1 The CONTRACTOR shall supply the materials required to be supplied within the Contractor's scope of supply for incorporation in the permanent works in accordance with and to meet the requirements in quality, quantity and other particulars of the descriptions, specifications, plans, drawings, designs and other documents applicable thereto, and the CONTRACTOR shall be deemed to have undertaken that all materials selected, procured and supplied by the CONTRACTOR within the scope of supply shall be of the best quality and workmanship and shall be capable of producing the designed desired results and to perform the designed and desired functions to meet the contractual requirements in all respects for the project.
- 4.2.2 The CONTRACTOR shall undertake and complete the supply of materials within the scope of supply to meet the scheduled progress and requirements of the WORK within the scope of work.
- 4.2.3 All materials shall be deemed to have been accepted only when the material is received at the project SITE and accepted by the ENGINEER-IN-CHARGE. Such acceptance shall however be subject to the terms and conditions of CONTRACT, including the right of rejection and/or replacement as elsewhere herein specified.
- 4.2.4 Without prejudice to any other terms of the contract, it is clarified that the mere agreement, acceptance or prescription of a Delivery or other Schedule containing an extended time of commencement or completion in respect of the entire delivery(ies) or any of them shall not anyway constitute an extension of time in a terms of the CONTRACT so as to bind the OWNER or relieve the CONTRACTOR of all or any of his liabilities under CONTRACT, nor shall constitute a promise on behalf of the OWNER or a waiver by the OWNER of any of its rights in terms of the contract relative to the performance of the CONTRACT within the time specified or otherwise, but shall be deemed only (at the most) to be a guidance to the CONTRACTOR for better organising his work on a recognition that the CONTRACTOR has failed to organise his supplies and/or make the same within the time specified in the Delivery Schedule.
- 4.2.5 If the CONTRACTOR fails to supply the materials in accordance with the dates in this behalf specified in the Delivery Schedule which has an impact on the critical path of the schedule, the CONTRACTOR shall provide the OWNER with a suitable plan to

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recover the delay, but without prejudice to any other rights, discount or remedy available to the OWNER in respect of such delay or failure.

4.2.6 MAKE OF MATERIALS

- i) All equipment and materials to be supplied under this CONTRACT shall be from approved vendors as indicated in the Bidding Document or as otherwise approved by the ENGINEER-IN-CHARGE / OWNER.
- ii) Where the makes of materials are not indicated in the Bidding document, the CONTRACTOR shall furnish details of proposed makes and supplies and supply the same after obtaining the OWNER's/ ENGINEER-IN-CHARGE's approval.

5.0 OWNER'S OBLIGATIONS:

The OWNER'S obligations are limited to the following:


- a) Handing over the substation site .
- b) Approval of Construction drawings supplied by the Contractor.
- c) Payment to the contractor for performance of work under the contract as per the terms and conditions specified therein.
- d) A piece of land for setting up temporary office, Godown, etc., if available.

6.0 POWER & WATER FOR CONSTRUCTION AND OTHER PURPOSES

Availability of water & power at site is very limited. Contractor shall have to make his own arrangements for Construction work.

7.0 RATES

- 7.1 OWNER shall pay to contractor the total rates quoted by them for the due and faithful performance of contractor's obligation under the contract. The rates quoted by the contractor in SOR shall remain fixed and firm and not subject to any escalation unless and otherwise specified in the tender.
- 7.2 The rates shall be deemed to allow for all minor extras and constructional details which are not specifically shown on drawings or given in the specifications but are essential in the opinion of the Owner/ Consultant to the execution of work to conform to good workmanship and sound engineering practice. The Owner / Consultant reserve the right to make any minor changes during the execution without any extra payment.
- 7.3 The Owner / Consultant decision to classify any item 'minor changes', 'minor extras' and 'constructional details' shall be final conclusive and binding on the Contractor.
- 7.4 Rates quoted shall include for payment of royalties for obtaining earth, morrum, sand, aggregates, stones, etc. Nothing extra shall be paid to the Contractor on this account.
- 7.5 Contractor shall be responsible for making all necessary approach roads to the sites of execution for taking his rigs, cranes & equipments. No extra claim in this regard shall be entertained.
- 7.6 Schedule of rates submitted by the Tenderer shall be the true copy of the schedule of rates enclosed with the tender documents

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7.7 The quantities and items of work given in the Schedule of Rates are tentative and approximate. The OWNER reserves the right to order variation of work during the currency of the contract of its original contract value within the stipulated variation as per clause no. 60.2 of GCC.

The contractor shall not be entitled to any **increase** whatsoever **on the SOR rates** on account of any variation in the quantities and/or omission/addition of items **vis-à-vis the quantities mentioned** in the “Schedule of Rates (**Section VII**)” as long as the contract value finally determined on the basis of the certified final quantities and the contract item rates is within the stipulated variation as per clause no. 60.2 of GCC.

8.0 SPECIFICATIONS

8.1 If specification for an item of work is not covered by CPWD/ BIS specifications or Technical Specifications, the same shall be decided by the Owner/ Consultant and shall be binding on the Contractor.

8.2 The Owner/ Consultant shall have the right to cause the Contractor to purchase and use such materials of particular make or from a particular source which may in his opinion be necessary for proper and reasonable compliance with the specifications and execution of work.

8.3 (a) As and when required by the Owner/ Consultant, the Contractor shall provide all facilities at site or at manufacture’s works or in approved laboratory for testing of materials and/or workmanship. All the expenditure in respect of this shall be borne by the Contractor. The Contractor shall, when required to do so by the Owner/Consultant, confirm that the materials have been tested in accordance with requirements of the specifications.

(b) Neither the omission by the Owner/ Consultant to test the materials nor the production of manufacturer(s) certificate, etc. shall affect the right of the Owner/Consultant to reject, after delivery, the materials found not in accordance with the specifications.

9.0 GATE PASSES

All tools, plant and materials shall be brought by the Contractor to the works site through a covering note to be submitted in 3 copies. One copy of the covering note will be delivered to the security staff and one copy to the Owner/Consultant. The third copy shall be retained by the Contractor. The Contractor shall follow all rules and regulations for entry / exit of their men and materials in/from project site as framed by Owner/Consultant.

10.0 TIME SCHEDULE

10.1 Bidder shall be required to complete the WORK under the CONTRACT so as to achieve the GUARANTEED COMPLETION DATE in accordance with the following:

Completion Period/ Completion Schedule	12 (Twelve) Months from date of issuance of FOA (Fax of Acceptance)
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Completion date shall be considered as date of issuance of Completion Certificate by TFL after successful Commissioning of the system.

10.2 The basic consideration and essence of the Contract is the strict adherence to the Time schedules for performing the specified works as stipulated in the Contract.

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10.3 If at any time, the Owner/Consultant is of opinion that the Contractor has fallen behind the approved construction schedule, the Owner/ Consultant may, without any cost to Owner/ Consultant, require the Contractor to take such steps as may be necessary to improve his progress, especially require him to employ overtime operations, increase the number of shifts, work on holidays and Sundays or increase the capacity of his construction plant and equipment and require him to submit evidence demonstrating the manner in which the Contractor proposes to comply with the construction schedule. Failure of the Contractor to comply with the above will be considered a failure to execute the work with due diligence.

10.4 Time schedule network/ bar chart.

10.4.1 Together with the Work Order/ Contract confirmation, Contractor shall submit to Owner/ Consultant, his time schedule regarding the documentation, supply of materials as well as information about of his Subcontracts to be placed with their parties, including the dates on which Contractor intends to issue such Subcontracts.

10.4.2 The time schedule will be in the form of a network or a bar chart clearly indicating all main or key events regarding documentation, supply of materials, delivery and site fabrication, erection, inspection, testing and completion.

10.4.3 The original issue and subsequent revisions of Contractor's time schedule and or Sub-contractor's time schedules shall be sent to Consultant in two copies (of which one shall be in Soft copy) and two copies to Owner.

10.4.4 The time schedule network/bar chart shall be updated at least every fortnight.

10.5 Progress Trend Chart/ Monthly Report

10.5.1 Contractor shall report weekly to Owner/ Consultant the progress of the execution of Work Order/ Contract and achievement of targets set out in time bar chart.

10.5.2 The progress will be expressed in percentages shown in the progress trend chart.



10.5.3 The first issue of the progress trend chart will be forwarded together with the time bar chart along with the Work Order confirmation.

10.5.4 The fortnightly reporting will bear the updating of the progress trend chart.

10.5.5 All reports shall be submitted through e-mail. Monthly reports to be also submitted in hard copy.

11.0 ISSUE OF WORKING DRAWINGS

All Working drawings shall be issued by OWNER/ CONSULTANT's to the CONTRACTOR. Working drawings submitted by the OWNER/ CONSULTANT's progressively during the pendency of the contract, shall be approved/ marked "Good for execution/ construction" by Owner/ Consultant. The Contractor on this account shall not be entitled to put forth any claim whatsoever on account of delay in approval of the drawings to the Owner/ Consultant. Fabrication drawing, if any shall be prepared by the contractor itself and same shall be approved by OWNER/ CONSULTANT's.

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12.0 SERVING OF NOTICES

The Contractor shall furnish to the Owner/ Consultant the name, designation and address of his authorized Agent for the purpose of serving of notice(s) regarding all complaints, communications and references and shall be deemed to have been duly given to the Contractor if delivered to the Contractor or his authorized agent or left at or posted to the address so given and shall be deemed to have reached such address in the ordinary course of post or on the day on which they were so delivered or left. In the case of contract by partnership firm, any change in the constitution of the firm shall be forthwith informed by the Contractor to the Owner/ Consultant.

- All correspondence from the CONTRACTOR to the OWNER shall be as per the correspondence distribution schedule. All communications including technical-commercial clarifications and/ or comments shall be addressed to OWNER/ CONSULTANT and shall always bear reference of DLOA number.
- Correspondence on technical and commercial matters shall be dealt with in separate letters and each copy of the letter shall be complete with all Annexures, if any.
- Any notice to the CONTRACTOR under the terms of the CONTRACT shall be served by registered e-mail/Speed Post, fax or courier.
- Any notice to the OWNER shall be served from the CONTRACTOR's Principal office in the same manner.
- Any written order or instruction of OWNER or his duly authorised representative, communicated to authorised representative of the CONTRACTOR at site office shall be deemed to have been communicated to the CONTRACTOR at his legal address.

13.0 NOTHING EXTRA FOR ADVERSE SUB-SOIL CONDITION



There may be variation in nature of sub-soil both horizontally and vertically. The Contractor shall have to take necessary precaution during excavation against any happening like collapsing of sides etc. Any slip or fall in excavation shall have to be cleared by the Contractor at his own cost. In case of excessive heaving, it shall have to be cut and refilled with lean concrete by the Contractor at his own cost. The Contractor shall have to adopt underwater work in case of occurrence of piping/quick conditions without any cost to Owner/Consultant.

14.0 CONTRACTOR'S RESPONSIBILITY FOR THE MANNER OF EXECUTION OF WORK

The Contractor shall be responsible for the manner and the method of executing the work. The work shall be subject to the approval of Owner/ Consultant from time to time for purposes of determination of the question whether the work is executed by the Contractor in accordance with the contract.

15.0 NO WORK SHALL BE UNDERTAKEN WITHOUT APPROVED WORKING DRAWINGS

No work shall be undertaken at Site by the Contractor until detailed approved working drawings are marked "Good for execution/ construction" by Owner/ Consultant. Any work done without the aforesaid approved working drawing shall be at the Contractor's own risk and costs.

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16.0 CONTRACTOR SHALL KEEP FOUNDATION PITS/TRENCHES DRY

The Contractor, during the pendency of contract, shall keep in dry condition of pits, trenches, which are not yet back filled due to technical reasons, if not shall be Bail-out/Pump-out all accumulation at his own cost for the safety of the structure / element. During pumping, the Contractor shall have to ensure that 'Loss of Ground' does not occur. Other approved methods shall be undertaken by the Contractor to avoid 'Loss of Ground' if occurred, at his own cost.

17.0 NOTHING EXTRA FOR INTRICATE CONCRETE SHUTTERING OR REINFORCEMENT WORK

Nothing extra shall be paid for any intricate concrete, shuttering or reinforcement work for foundations of equipment and machinery and for other foundation/superstructure works or for any delay inherent in concreting in small and thin sections in concrete or RCC works etc.

18.0 NOTHING EXTRA FOR REBATING ETC.

Nothing extra shall be paid in concrete/RCC works for all rebating, chamfering, grooving, sinking, trotting weathering, moulding, etc. to accord with the details shown on the working drawings.

19.0 CONSTRUCTION JOINTS

19.1 In case of execution of massive concrete elements both in foundation and in superstructure and in some other locations as would be permitted except where specified in the working drawings, the work shall be carried out in one single operation without any break in concreting within time limit that would be specified by the Owner / Consultant without any additional cost to Owner/ Consultant.

19.2 All specified construction joints, either horizontal or vertical, in any element of concrete member shall be provided with shear keys of such dimensions as would be determined by the Owner/Consultant. Before adopting the next operation for the other half of the element these shear keys along with the entire surface of the joint shall be roughened and deepened to above 20 mm by chipping, washing and cleaning thoroughly. The Contractor shall provide cement slurry in sufficient quantity over the cleaned surface for proper bond as per the direction of Owner/Consultant. The Contractor shall not be entitled to any extra/payment; on this account.

20.0 SUBMISSION OF BILL

Contractor is to submit the bills and record of measurements in three (3) copies for works executed by him.

20.1 FOR R/A BILLS:

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Contractor is to submit the bills and record of measurements to EIC complete in all respect for certification by Owner/Consultant in three copies for works executed by him progressively.

20.2 MEASUREMENT OF WORKS

In addition to the provisions of relevant Clause of GCC, following shall also apply:

Measurement of work shall be made in the units mentioned in the schedule of rates. The abbreviations used in the schedule of rates are mentioned in Schedule of Rates.

The Engineer-in-Charge shall, except as otherwise stated ascertain and determine by measurement the value of Work done, in accordance with the Contract and as per actual Work done. The Engineer-in-Charge shall, when he requires any part or parts of the Works to be measured, give notices to the Contractor's authorized agent or representative who shall forthwith attend or send a qualified agent to assist the Engineer-in-Charge in making such measurement and shall furnish all particulars required by either of them. Should the Contractor not attend or neglect or omit to send such representative then the measurement made by the Engineer-in-Charge shall be taken to be the correct measurement of the Work. For all measurements, figured dimensions given in the drawings shall be followed. Measurement of all hidden items shall be carried out by the Engineer-in-Charge. The Contractor or his representative who attends may at the time of measurement take such notes and measurements as he may desire.

The measurements for excavations shall be restricted and limited to minimum excavation line as per drawing for payment purposes.

20.3 DISPUTE IN MODE OF MEASUREMENT

Where Works have to be measured for any purpose whatsoever, it shall be in accordance with item specifications as per relevant Indian Standards unless otherwise specifically indicated in the Contract Specifications. All measurements will be recorded in metric units only. In case of absence of mode of measurement of any item not covered by both the methods mentioned above, the Engineer-in-Charge's decision shall be final and binding. The required number of bills, registers, bill forms, level/field books, materials/ account registers, testing registers, site order books and any other stationary item pertaining to this contract shall be printed and provided for by the contractor, at his own cost in the format prescribed and approved by the Engineer-in-Charge in writing. The Measurement Sheet will have three copies in different colour pages and will be printed so that proper referring and record of complete measurement is maintained. Original sheet will be retained in the book and will be returned to Owner on completion of Work.

20.4 SUBMISSION OF FINAL BILL

The final bill complete in all respect shall be submitted after certified completion of work.

20.4.1 On the basis of the rates provided in the CONTRACT and subsequent Change Order(s)/Amendment(s), if any, the CONTRACTOR shall prepare the Final Bill as per GST norms. Additions claimed on account of CHANGE ORDER(s) shall be separately indicated in the Final Bill with reference to the relative CHANGE ORDERS(s).

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20.4.2 The Final Bill shall, in addition to the payment entitlements arrived at according to the provisions of Clause 20.4.1 hereof shall separately state and include therein all claims of the CONTRACTOR, if any, with full particulars of the nature of such claim and grounds on which it is based and the amount claimed.

20.4.3 The Final Bill drawn in accordance with Clause 20.4.1 shall be submitted (together with the COMPLETION CERTIFICATE along with other documents as stipulated at Clause No. 39.8 of SCC, to the ENGINEER-IN-CHARGE for certification, who shall certify the Final Bill, if drawn in accordance with Clause 20.4.1. After certification of the ENGINEER-IN-CHARGE, the Final Bill shall be submitted in quadruplicate (or in such other number of copies as the OWNER may prescribe) to the OWNER for payment.

20.4.4 All monies payable under the CONTRACT for WORKS to be performed and MATERIALS to be supplied up to and including successful completion shall become due and payable to the CONTRACTOR only after submission to the OWNER of the Final Bill prepared in accordance with the provisions of Clause 20.4.1 hereof and associated provisions there under accompanied by the COMPLETION CERTIFICATE in respect of the WORKS.

20.4.5 Payments of the amount(s) due on the Final Bill to the extent certified by the ENGINEER-IN-CHARGE, shall be made within 30 (Thirty) days from the due date as specified in Clause 20.4.4 hereof, subject to the deductions provided in Clause 20.4.5.1.

20.4.5.1 All payments due to the CONTRACTOR on the Final Bill shall be subject to tax deductions and any other deductions provided in the CONTRACT or required to be made under any law, rule or regulation having the force of law for the time being applicable, or elsewhere provided for in the CONTRACT documents.

21.0 CLAIMS BY THE CONTRACTOR

21.1 No claim(s) shall on any account be made by the CONTRACTOR after submission of the Final Bill, with the intent that the Final Bill prepared by the CONTRACTOR shall reflect any and all claims whatsoever of the CONTRACTOR against the OWNER arising out of or in connection with the CONTRACT or any supply made or work performed by the CONTRACTOR there under or in relation thereto, and notwithstanding any enabling provision in any law or CONTRACT and notwithstanding any claim that the CONTRACTOR could have with respect thereto, the CONTRACTOR hereby waives and relinquishes any and all such claims not included in the Final Bill and absolves and discharges the OWNER from and against the same, even if in not including the same as aforesaid, the CONTRACTOR shall have acted under a mistake of law or of fact, or shall claim to have acted under economic compulsion or necessity.

21.2 If required by the OWNER, the ENGINEER-IN-CHARGE shall be authorised to require the CONTRACTOR to furnish, and the CONTRACTOR shall, upon the request of the ENGINEER-IN-CHARGE /OWNER, furnish all invoices, vouchers and accounting records as may be deemed necessary by the ENGINEER-IN-CHARGE /OWNER for the purpose of verifying any CONTRACTOR's claim.

22.0 PROVISION FOR MULTIFARIOUS CHECKING OF WORK

Before commencement of the actual concreting operation the position and layout of foundations, pedestals, inserts, pockets, recess, reinforcement and form work shall be checked repeatedly by Owner/Consultant. No claim whatsoever shall be entertained on

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this account. The level of foundations shall be accurately maintained as shown in the drawings or as directed by the Owner/Consultant. No padding, plastering or chipping shall be allowed for achieving the results.

23.0 DEFECT LIABILITY PERIOD

Defect Liability Period shall be 12 months from the date of completion of works in all respects as declared by EIC.

24.0 CLEARING, FILLING AND LEVELING OF SITE

The site shown on the layout plan shall be cleared by the Contractor of all obstructions, loose stones, materials, rubbish of all kinds of bushes, trees, grass as well as brush wood. All holes/hollow, whether originally existing or produced by removal of loose stones or brush wood, shall be carefully filled up with earth, well rammed and levelled off as directed by the Owner/ Consultant. The Contractor will not be entitled to any payment in his regard.

25.0 CONTRACTOR TO COMPLY ALL LAWS

25.1 The contract shall be governed by the law in force in the Republic of India.

25.2 The Contractor shall comply with all laws etc. The Contractor shall be responsible to secure compliance with the Central and States Laws as well as the Rules, Regulations, by-laws and orders of the legal authorities and statutory bodies which are in force or as may be in force from time to time. He shall give to the Municipal Corporation Committees, police and other relevant authorities all such notices, etc. as may be required by law and obtain all requisite license for temporary constructions, enclosures, etc. and pay all fees, taxes and such other dues or charges which may be leviable on account of any of his operations in executing the works under this contract. Owner/Consultant shall not pay anything extra to the Contractor on this account. The Contractor shall also make good at his own cost, any damage done by him to any adjoining property, during execution of work.

26.0 CONTRACTOR TO USE THE MATERIALS ONLY AFTER THE APPROVAL OF OWNER


The Contractor shall use the raw materials only after its successful testing at any NABL accredited lab and subsequent concurrence of the report by the Owner/ Consultant, before incorporation of the same in the works.

27.0 COMPLIANCE OF ENTIRE PROVISIONS IS OBLIGATORY TO CONTRACTOR

It shall always prevail, unless otherwise specifically stated, that the entire provisions of the Tender Document have been accepted for compliance by the Contractor without any reservation.

28.0 DELIVERY AND DOCUMENTS

Delivery of the Goods shall be made by the Contractor in accordance with the terms specified by the Owner/Consultant in the schedule of requirements in Technical Specifications and the special conditions of Contract.

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29.0 WEATHER CONDITIONS

Owner/Consultant may order Contractor to suspend any work which in the opinion of Owner/Consultant may be subject to damage by prevailing weather conditions. No claim whatsoever on this account shall be entertained.

It is presumed that the Contractor has familiarized himself with the weather conditions prevailing in the area therefore in such weather parameters if it appears to the Engineer –in –charge (EIC) that certain weather condition may damage the work or specified quality of the work can be achieved without stoppage of the work, the EIC in such conditions may require the Contractor to stop the work till such time as he thinks fit and appropriate. It is understood by the contractor that no compensation will be admissible on this count.

30.0 INSTRUCTIONS, DIRECTIONS AND CORRESPONDENCE

30.1 The work described in Contract is to be executed according to the standards, data sheets, tables, Specifications and Drawings and according to all conditions both general and specific enclosed with the Tender document, unless any or all of them shall have been modified or cancelled in writing as a whole or in part.

- i) All instructions and orders to Contractor shall, except what is herein provided, given by Owner/Consultant.
- ii) All the work shall be carried out under the direction of and to the satisfaction of Owner/Consultant.
- iii) All communications including technical/commercial clarifications and/or comments shall bear reference to the DLOA/ Contract.
- iv) Invoice for payment against DLOA/ Contract shall be addressed to Owner/ Consultant.
- v) The DLOA number shall be shown on all invoices, communications, packing lists, containers and bills of lading etc.



30.2 Correspondence on technical and commercial matters shall be dealt with in separate letters and each copy of the letter shall be complete with all Annexures. Wherever possible, correspondence should be through e-mails.

30.3 Correspondence for expediting any Material Inspection , shall be done directly with CONSULTANT & OWNER.

31.0 QUALITY ASSURANCE / QUALITY CONTROL

31.1 After the award of the contract detailed quality assurance programme shall be prepared by the Contractor for the execution of contract for various works which will be mutually discussed and agreed to.

31.2 The Contractor shall establish document and maintain an effective quality assurance system outlined in recognized codes.

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- 31.3 Quality Assurance System plans/procedures of the Contractor shall be furnished in the form of a QA manual after award of job. This document should cover details of the personnel responsible for the Quality Assurance, plans or procedures to be followed for quality control in respect of Design, Engineering, Procurement, Supply, Installation, Testing and completion in all respect till final acceptance by Owner. The quality assurance system should indicate organizational approach for quality control and quality assurance of the construction activities, at all stages of work at site.
- 31.4 The Owner/ Consultant or their representative shall reserve the right to inspect/ witness, review any or all stages of work at shop/site as deemed necessary for quality assurance.
- 31.5 The Contractor has to ensure the deployment of quality Assurance and Quality Control Engineer(s) depending upon the quantum of work. This QA/QC group shall be fully responsible to carry out the work as per standards and all code requirements. In case Engineer-in-charge feels that Contractor's QA/QC Engineer(s) are incompetent or insufficient, Contractor has to deploy other experienced Engineer(s) as per site requirement and to the full satisfaction of Engineer-In-Charge.
- 31.6 In case Contractor fails to follow the instructions of Engineer-in-charge with respect to above clauses, next payment due to him shall not be released unless until he complies with the instructions to the full satisfaction of Engineer-in-charge.
- 31.7 The Contractor shall adhere to the approved quality assurance system

32.0 HEALTH SAFETY AND ENVIRONMENT (HSE) MANAGEMENT

The Contractor, during entire duration of the Contract, shall adhere to HSE requirement as per Specification enclosed in the Bidding Document as per **Annexure - I (Annexure to Special Conditions of Contract)**

33.0 SUSPENSION OF WORKS

- 33.1 The OWNER reserves the right to suspend and reinstate execution of the whole or any part of the WORK without invalidating the provisions of the CONTRACT. Orders for suspension or reinstatement of the WORKS will be issued by the OWNER to the CONTRACTOR in writing. The time for completion of the WORKS will be extended for a period equal to the duration of the suspension along with mutually agreed remobilization period.
- 33.2 If such suspension of WORK by OWNER delays or is likely to delay the progress of WORK or the carrying out of WORK under CONTRACT resulting in additional expenses or increased liability to CONTRACTOR, the OWNER shall pay to the CONTRACTOR all reasonable expenses, mutually agreed between OWNER and CONTRACTOR, arising from suspension of the work by an order in writing of the OWNER provided that such suspensions of work is more than a cumulative period of Sixty days (60) days and provided that such suspension is not due to some fault on the part of the CONTRACTOR or a SUB-CONTRACTOR.
- 33.3 If the OWNER has;
- (i) failed to pay the CONTRACTOR any sum due under the CONTRACT within the period specified in the Contract; or

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- (ii) failed to approve invoice or supporting document without just cause within the period specified in the Contract; or
- (iii) committed substantial breach of the Contract:

Then, CONTRACTOR may give a notice requesting OWNER to remedy aforesaid default within 30 days. If OWNER fails to remedy it within the said period, CONTRACTOR may suspend the performance of its obligations under the CONTRACT.

33.4 If the CONTRACTOR's performance of its obligations is suspended under the CONTRACT pursuant to clause 33.3 as above, then the COMPLETION TIME shall be extended and all reasonable additional costs or expenses incurred by the CONTRACTOR and mutually agreed between OWNER and CONTRACTOR, as a result of such suspension shall be paid by the OWNER to the CONTRACTOR provided that such suspension is not due to fault on the part of CONTRACTOR or its SUB CONTRACTOR.

34.0 INCOMING MATERIAL REPORT/ INSPECTION

All material entering the site shall be properly recorded by contractor's representative with detail of challan, bill and quantity.

- a) All equipment shall be inspected and tested as per an agreed Quality Assurance Plan before the same is packed and dispatched from the Contractor's/ Vendor's Works. The Contractor shall carry out tests as specified/ directed by Engineer.
- b) Contractor shall perform all such tests as may be necessary to meet requirements of Local Authorities, Municipal or other statutory laws/ bye-laws in force. No extra shall be paid for these.
- c) The OWNER/ CONSULTANT may, at his sole discretion, carry out inspection at different stages during manufacturing and final testing after manufacturing.
- d) Approvals or passing of any inspection by the OWNER/ CONSULTANT or his authorized representative shall not however, prejudice the right of the OWNER/ CONSULTANT to reject the plan if it does not comply with the specification when erected or give complete satisfaction in service.
- e) All materials and equipment found defective shall be replaced and the whole work again tested to meet the requirements of the specifications, at the cost of the contractor. Contractor has to obtain a performance certificate/approval for the complete layout of piping/equipment erected.

35.0 INSPECTION

35.1 Inspection of equipment/ materials at manufacturer/ supplier works, prior to dispatch shall be carried out by OWNER and/or CONSULTANT unless is explicitly waived off (in writing) by the OWNER and/or CONSULTANT.

35.2 Once the materials are ready for inspection, the materials will be offered for inspection to OWNER through proper channel. The offer of the inspection should contain the following documents and information;

- i) List of materials/equipment

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- ii) Quantity to be inspected
- iii) Routine test certificates of the equipment/materials
- iv) Name of the Vendors
- v) Place of inspection with detail address
- vi) Name of contact persons with telephone numbers
- vii) Bill of Materials in case of Tower materials and sub-station structures

35.3 Inspection by OPTCL

35.3.1 The inspection of materials/equipment by OPTCL shall be carried out at CONTRACTOR'S cost. The tour cost of OPTCL's inspecting officer will be borne by the CONTRACTOR. The deputation of the inspecting officers of OPTCL for witnessing the acceptance test will be decided & communicated to all concerned after receipt of above mentioned documents & scrutiny thereof.

35.3.2 The inspection will be witnessed by the OPTCL inspecting officer as per OPTCL practice in the presence of the representative of the manufacturer and TFL/CONSULTANT. The inspecting officer will submit the inspection report, test result, minutes of discussion, calibration certificates of the measuring and testing instruments etc. to OPTCL office.

If the test results are acceptable and the observations made by the inspecting officer are complied with, a dispatch instruction will be issued from OPTCL office Materials/equipment procured and received at site, contrary to the procedure enumerated above, shall not be allowed to be used in construction activities involving OPTCL transmission network.

35.3.3 Expenses in respect of OPTCL's representative for witnessing the inspection & testing of the offered equipment/materials at the inspection and testing site.

OPTCL inspecting officer on receipt of offer for inspection from the contractor/supplier, shall proceed to the manufacturer works to witness the Type/Acceptance/Routine test.

35.3.4 The travel expenses under the following heads, in respect of OPTCL's representative for witnessing the inspection & testing of the offered equipment/materials at the inspection and testing site, shall be borne by the contractor.

a. Hotel Accommodation:

- Single room accommodation in 4 star hotel for OPTCL inspecting officer, not below the rank of Assistant General Manager (Grade E-6),
- Single room accommodation in 3 star hotel for OPTCL inspecting officer of the rank below Assistant General Manager (Grade E-6).

N.B.: It is the responsibility of the contractor to arrange the hotel accommodation matching with their inspection and testing schedule. In case of extended duration of inspection or non-availability of the return ticket, Contractor shall arrange for the extended stay of the inspecting officer in the Hotel accordingly. In case, there is no hotel with prescribed standard in and around the place of inspection, the contractor

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shall suggest alternative suitable arrangement at the time of offer for inspection, which is subjected to acceptability of OPTCL inspecting officer.

b. Journey of the Inspecting Officer:

To and fro travel expenditure from the Head Quarters of the inspecting officer to the place of inspection/testing shall be borne by the contractor as per the following.

- Journey from the Head Quarters to the nearest Airport by train (1st/Ind A/C) or Taxi (A/C).
- Journey from destination Airport to the place of inspection/testing by train (1st/Ind A/C) or Taxi (A/C).
- For train journey, inspecting officer, not below the rank of Assistant General Manager shall be provided with 1st class AC ticket and inspecting officer below the rank of Assistant General Manager shall be provided with 2nd class AC ticket.

- Booking/cancellation of Air-ticket / Train-ticket is the responsibility of the contractor.
- Moreover, if during the journey there is an unavoidable necessity for intermediate travel by road/ waterway/sea-route, the contractor/supplier shall provide suitable conveyance to the inspecting officer for travel this stretch of journey or bear the cost towards this. Any such possibilities shall be duly intimated to OPTCL at the time of their offer for inspection.

c. Local Conveyance: Local journey for the inspecting officer between Hotel and the place of the inspection/testing site, Air-conditioned four wheeler vehicles in good condition shall be provided by the contractor.

d. Other Important Information:

- All the above expenses shall be deemed to be included in the bidder's quoted price for that supply item. Bidder shall not be eligible to raise any extra claim in this regard.
- Contractor may assume that only in 40% of the inspection and testing offer cases, OPTCL/TPIA inspecting officer (not below the rank of Assistant General Manager) will witness the inspection and testing.
- In case of inspection and testing of some critical equipment/materials like Power Transformers, CT, PT, Breakers, S/S Automation Equipment and Cable, OPTCL may depute more than one inspecting officer.
- Contractor shall judiciously plan the inspection/testing schedule and place of inspection/testing, so that optimum number of inspection/testing and minimum time shall be required to cover all the equipment/materials of the relevant contract package.

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- It shall be the responsibility of the Contractor to organize the above tour related matters of OPTCL inspecting officer including the matters related to overseas inspection/testing, if any.
- e. Providing vehicle to the field Engineers for proper supervision of site works:
- For effective monitoring of the site works, the contractor shall submit monthly and weekly program of site work well in advance in prescribed format to OPTCL site engineer.
 - In case of transmission line work, the contractor shall clearly indicate the location no. in the program.
 - Contractor shall provide a four wheeler vehicle in good running condition and suitable for the site use to the field officers of the respective head-quarters to visit different work locations for monitoring the site works as per the program and back to the headquarters after monitoring the work.

Note: The expenses towards above, including cost pertaining to up-keeping cost of the vehicle, i.e. fuel, driver etc., shall be deemed to be included in the bidder's quoted price without any additional financial implication to OPTCL. Bidder shall not be eligible to raise any extra claim in this regard.

35.3.5 The materials shall be inspected by OPTCL or any authorized representative of OPTCL at the Contractor's or its Vendor's manufacturing works. The Contractor shall give the advance notice in writing about the place of Inspection and/or testing atleast 15 days before the schedule date on which the equipment/materials will be ready for Inspection and/or Testing. Routine test certificates are to be submitted along with the offer for inspection.

35.3.6 The OPTCL or his representative shall be entitled at all reasonable times during manufacture / installation to inspect examine and test the equipment/materials at the contractor's/Vendors premises / erection site about workmanship of the materials to be supplied under this contract. The contractor shall provide unhindered clearance, giving full rights to OPTCL to inspect, examine and test as if the equipment/materials were being manufactured in his premises/Vendors Premises. Such inspection/examination and testing shall not relieve the contractor of his obligations under the contract.

35.3.7 The Engineer-In-Charge shall have the right to re-inspect any equipment/materials though previously inspected and approved by him at the Contractor's or its Vendor's works, before and after the same are erected at Site. If by the above inspection, OPTCL rejects any equipment, the Contractor shall make good for such rejections either by replacement or modifications/repairs as may be necessary to the satisfaction of the Engineer-In-Charge, free of cost. Such replacement will also include the replacements or re-execution of such of those works of other Contractors and/or agencies, which

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might have got damaged or affected by the replacements or re-work done to the Contractor's/Vendor's work.

The OWNER/ CONSULTANT's Engineer may, at his sole discretion, carry out inspection at different stages during manufacturing and final testing after manufacturing. Testing performed in the presence of the Purchaser's representatives shall not relieve the supplier of their own responsibilities and guarantees and any other contractual obligations.

36.0 SECURITIES OF MATERIALS / EQUIPMENTS

Contractor shall be solely responsible for the security of the material at site and TFL/ Consultant shall not be responsible for any loss/theft of the materials.

- a) Materials required for the works, whether brought by the Contractor shall be stored by the Contractor only at places approved by the Engineer-in-Charge, as storage and safe custody of material shall be responsibility of the Contractor.
- b) TFL,'s officials concerned with the Contract shall be entitled at any time to inspect and examine any materials intended to be used in or on the works, either on the site or at factory or workshop or other place(s) where such materials are assembled, fabricated, manufactured or at any place(s) where these are lying or from which these are being obtained and the Contractor shall give such facilities as may be required for such inspection and examination.
- c) The contractor shall be the OWNER of all bought out items and materials and shall be responsible for the safety, security, insurance and care and custody of all the materials lying at site. TFL will have lien on all the items including those brought by the contractor for the purpose of Erection, testing, and commissioning of the work. For all Equipments/Materials, the title of Ownership shall pass on to the OWNER at the time of acceptance of entire work.

However, in case of termination of contract the transfer of title shall pass automatically to OWNER.

- d) CONSTRUCTION EQUIPMENT used by the CONTRACTOR and its SUB-CONTRACTORS in connection with the execution of works shall remain the property of CONTRACTOR or its SUB-CONTRACTORS. All duties, levies, taxes etc. payable on account of CONSTRUCTION EQUIPMENT shall be borne by the CONTRACTOR. CONTRACTOR shall indemnify the OWNER on this count.

37.0 CONTRACTOR'S PERSONNEL AT SITE:

List of persons employed by Contractor for the subject work mentioning there residential address shall be submitted to TFL. In case of any revision, the same shall be informed to TFL from time-to-time. If required necessary verification from Police / Gram Pradhan shall have to be submitted by the contractor.

The Contractor shall be directly responsible for any/all disputes arising between him and his personnel and keep indemnified against all losses, damage and claims arising thereof.

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Within the TFL's premises, the Contractor's personnel shall not do any private work other than their normal duties.

The personnel engaged by the Contractor shall be subject to security check by the TFL's security staff while entering/leaving the premises. The contractor & his personnel shall be required to follow the rules and regulations of TFL in force from time-to-time. The contractor may also be required to provide photo passes to the personnel required by him, for security and safety reasons and furnished the details of the same when asked for.

No other person except Contractor's authorized representative shall be allowed to enter TFL premises Contractor shall also not entertain any outsider or extend any service beyond TFL's premises. Entry of Contractor's persons shall be regulated with proper identity/gate pass.

Contractor shall be fully responsible for theft, burglary, fire or any mischievous deeds by his staff and any loss to TFL shall be recovered from the immediate bill of the Contractor.

Contractor shall provide all necessary tools and tackles, equipments, safety belt, wheel burrow, scaffolding, ladders, drilling m/c & safety equipment etc. required to carry out job at his cost and material used by Contractor shall be of standard make and approval of Engineer-In-Charge shall be taken for the same.

TFL also reserves the right to ask the Contractor to remove particular person(s) from site with immediate effect if in the opinion of TFL, his behaviour/ performance is not up to the mark and/or found indulging in unlawful activities, Contractor shall immediately comply with such instructions.

It will be the responsibility of contractor's engineer to ensure that their personnel behave in a proper manners and behaviour and not to undergo the argument with the employees. It will be the responsibility of the Contractor's Engineer to deal with such complaints or co-ordinate with the TFL Engineer.



38.0 SETTING OUT THE WORKS

The CONTRACTOR shall supply dimensioned drawings, levels and other information necessary to set out the works and the Contractor shall set out the works and be responsible for the accuracy of the same. He shall rectify at his own cost and to the satisfaction of the Engineer-in-Charge any error found at any stage which may arise through in accurate setting out. The Contractor shall protect and preserve all bench marks used in setting out the works till end of the Defects Liability Period unless the Engineer-in-Charge direct their earlier removal.



39.0 COMPLIANCE WITH LABOUR/ INDUSTRIAL LAWS

RESPONSIBILITIES OF THE CONTRACTOR AND COMPLIANCE WITH LABOUR/ INDUSTRIAL LAWS:

- a. The contractor shall have his own PF code no. with the RPFC as required under Employee PF & Miscellaneous Provisions Act, 1952 and ESI code No. required under Employee State Insurance Act 1948 before commencement of work.

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- b. The contractors shall periodically submit the challans / receipts / proof for the depositing PF contribution with RPF and ESIC.
- c. The contractor is required to obtain labour license under the provisions of Contract Labour (R&A) Act, 1970 from the office of ALC (Central), Ministry of Labour, Govt. of India.
- d. The contractor is liable to abide by all necessary licenses / permissions from the concerned authorities as provided under the various labor legislations
- e. The contractor shall discharge obligations as provided under various statutory enactments including the employees Provident Fund and Miscellaneous Provisions Act, 1952, Contract Labour (R&A) Act, 1970, Minimum Wages Act, 1948, Payment of wages act 1936, Workman Compensation Act 1923, Employees' State Insurance Act 1948 and other relevant acts, rules and regulations enforced from time to time.
- f. The contractor shall be solely responsible for the payment of wages and other dues to the personnel, if any, deployed by him latest by 7th day of the subsequent month.
- g. The contractor shall be solely responsible and indemnify the TFL against all charges, dues, claim etc. arising out of the disputes relating to the dues and employment of personnel, if any, deployed by him.
- h. The contractor shall indemnify TFL against all losses or damages, if any, caused to it on account of acts of the personnel, if any, deployed by him.
- i. All personnel deployed by the contractor should be on the rolls of the contractor.
- j. The contractor shall ensure regular and effective supervision and control of the personnel, if any, deployed by him and gives suitable direction for undertaking the contractual obligations.
- k. The personnel to be deputed by the contractor shall observe all security, fire and safety rules of TFL while at the site. His Work/Services will be supervised by the supervisors of contractor. Contractor has to strictly adhere to guidance, instruction when required.
- l. Contractor shall provide proper identification cards for his employees to be deputed by him for Work/Services, duly signed by the contractor or authorized person on behalf of contractor. Also the contractor should obtain entry passes from Security Dept. through OPERATION-IN-CHARGE for his employees.
- m. Contractor has to deploy the personnel with no past criminal records. Reformed people, names of such persons should be clearly indicated in case of. Also the contractor has to provide police verification for all the persons deployed by him.
- n. While confirming to any of these conditions, the contractor should ensure that no law of state regarding labour, their welfare, conduct etc, is violated. The contractor shall indemnify TFL for any action brought against him for violation, non-compliance of any act, rules & regulation of centre / state / local statutory authorities.
- o. All existing and amended safety / fire rules of TFL are to be followed at the work site.

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- p. Contractor shall ensure payment of wages to the personnel employed and meet all statutory obligations of payment as per Minimum Wages act 1948 and payment of wages Act 1936.
- q. Special safety equipment e.g. safety belts, helmets, hand gloves, goggles, safety shoes etc shall be provided to the personnel engaged by the contractor.
- r. Suitable site office space may be provided by TFL if required and available.
- s. In case of accident, injury and death caused to the employee of the contractor while executing the Work under the contract, the contractor shall be solely responsible for payment of adequate compensation, insurance money etc. to the next kith & kin of injured / diseased. Contractor shall indemnify TFL from such liabilities.
- t. The contractor shall also undertake to obtain necessary group insurance coverage covering all risks connected with the job to be undertaken by him under the contract from insurance company and pay the premium accordingly.
- u. The contractor shall not employ or permit to be employed any person suffering from any contagious, loathsome or infectious disease. The contractor shall get examined his employees / persons deployed from a civil govt. doctor.
- v. No employees or person of contractor (including contractor) be allowed to consume alcoholic drinks or any narcotics within the plant premises. If found under the influence of above, the owner / TFL will terminate the contract immediately and may refer the case to police.
- w. The contractor hereby agrees to indemnify owner/ TFL and harmless from all claims, demands, actions, cost and charges etc brought by any court, competent authority/ statutory authorities against owner/ TFL.
- x. All registration and statutory inspection fees, if any, in respect of his work pursuant to this Contract shall be to the account of the Contractor. However, any registration, statutory inspection fees lawfully payable under any statutory laws and its amendments from time to time during erection in respect of the equipment ultimately to be owned by OPTCL, shall be to the account of OPTCL. Should any such inspection or registration need to be re-arranged due to the fault of the Contractor or his Sub Contractor, the additional fees to such inspection and/or registration shall be borne by the Contractor



40.0 TERMS OF PAYMENT

Payment shall be released after submitting valid Tax Invoice. GST no. of Contractor as well as Owner should be mentioned by the Contractor on Invoice.

Following terms of payment shall be applicable:

40.1 **Mobilization Advance:** Not Applicable

40.2 **Running on Account Payment**

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Contractor shall raise the invoice for the 100% completed job against the RA bill and payment shall be release as per following manner:

A) For Civil, works

➤ 95% against the value of actual work done shall be paid against running bills certified by OWNER/CONSULTANT after recovery of following payments:

- a) Value of chargeable materials issued by OWNER/CONSULTANT, if any
- b) Mobilization advances if any.
- c) Statutory deductions like income tax, etc. as applicable.
- d) Any other recovery if becomes due.
- e) Value of Chargeable Service provided by owner/Consultant, if any

Payment shall not be released against 1st R/A bill until submission of following documents by contractor to the indenting department.

1. Contract Performance Security
2. Labour License (as per statutory requirements)
3. EPF Code Registration number
4. Insurance Contractor All Risk (CAR) Policy
5. Workmen compensation policy

➤ Balance 5% (Retention Money) shall be released along with final bill.

B) Electrical Works:

I) 220kV GIS Substation & associated 220kV U/G Cabling works;

a) For Supply Items (excluding Mandatory Spares);

- 20% upon successful Inspection and Dispatch Clearance
- 60% upon receipt, storage and physical verification at site
- 10% on completion of individual Testing of equipment
- 5% on Successful completion of erection testing and commissioning of the 220kV Substation and associated 220kV U/G Cabling works
- Balance 5% (Retention Money) shall be released along with final bill

b) For Supply of Mandatory Spares;

- 20% upon successful Inspection and Dispatch Clearance.
- 75% upon receipt, storage and physical verification at site.
- Balance 5% (Retention Money) shall be released along with final bill

For Erection Items;

- 80% on completion of each of the items of Erection activity
- 15% on Successful completion of erection, testing and commissioning of the 220kV GIS Substation and 220kV U/G Cabling works
- Balance 5% (Retention Money) shall be released along with final bill

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II) For Items involving both Supply & Erection

- 65% on receipt and storage at site and on physical verification and furnishing of necessary certificate by Employer's representative.
- 20% on its completion of erection / Installation.
- 10% on its testing and commissioning.
- Balance 5% (Retention Money) shall be released along with final bill.

III) For Lump sum/Lot Items:

- 70% shall be paid on receipt and acceptance of material at site on pro rata basis
- 20% on completion of erection / Installation pro rata basis
- 5% on Inspection & testing pro rata basis
- Balance 5% (Retention Money) shall be released along with final bill

Note: Bidder shall submit the breakup details of LOT items before submission of invoice

C) Payment towards Short Circuit Testing of 220/33kV 20 MVA Power Transformer;

- 80% shall be paid against successful completion of the Short Circuit Test and issuance of Provisional Report by the Test Conducting Authority
- 15% shall be paid against submission of Final Report by the Test Conducting Authority
- Balance 5% (Retention Money) shall be released along with final bill

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40.3 Payment shall be released for supply of materials (wherever applicable) on submission of the following documents:

1. Signed Invoice(s)
2. Delivery Challan
3. Manufacturer's certificate of inspection for shipment in one original and one photocopy / Manufacturer's test certificate (wherever applicable)
4. Inspection Release Note clearly indicating that material has been inspected and accepted as per QAP approved by OWNER, or waiver certificate issued by OWNER (wherever applicable).
5. Railway Receipt/LR (wherever applicable)
6. Insurance Certificate/Intimation
7. Guarantee/ Warranty certificate (wherever applicable)
8. Operation & Maintenance manual (wherever applicable)

Note :

- 1) The amount of CGST & SGST or IGST and GST cess, if any will be released when the same will appear in the GSTR-2A of OWNER, in the common portal of GST and supplier has filed the valid return in accordance with the provisions of the GST Act and the rules made there under. If, input tax credit is not available to OWNER for any reason attributable to the bidder, then OWNER shall not be obligatory or liable to pay or reimburse GST claimed in invoice and shall be entitled to deduct /setoff/ recover such GST together with all the penalty and interest if any, against any paid or payable to bidder. Further in this case, OWNER reserves the right to upload the name of such defaulter on the Company website and may also consider for giving Holiday or debarred from participation in future tender.
- 2) Set / Lot / Lumpsum shall be governed as per the requirement of the corresponding item description read in conjunction with relevant provisions of Technical Specifications and the Billing breakup referred to above shall be issued by the Employer based on Contractor's request, if and as may be required during the currency of the Contract

The bid price for which the quantities are to be estimated by the Bidder shall remain constant unless there is change made in the Scope of Work by Employer. The quantities and unit prices (i) subsequently arrived while approving the Bill of Quantities (BOQ) / Billing breakup of lumpsum quantities/ lot/ Set and/ or (ii) estimated by the bidder shall be for on account payment purpose only. In case additional quantities, over and above the quantities BOQ/billing breakup and /or estimated by the bidder, are required for successful completion of the scope of work as per Technical Specification, the Bidder shall execute additional quantities of these items for which no additional payment shall be made over and above the lumpsum bid price. In case quantities of these items supplied at site are in excess of that required for successful completion of scope of work, such additional quantities shall be the property of the bidders and they shall be allowed to take back the same from the site for which no deduction from the lumpsum bid price shall be made. Further, in case actual requirement of quantities for successful completion of scope of work is less than the quantities identified in the approved BOQ /billing breakup and/or estimated by the bidder, the lumpsum bid price shall remain

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unchanged and no deduction shall be made from the lumpsum price due to such reduction of quantities

40.4 **PAYING AUTHORITY**

Director (Finance),
Talcher Fertilizers Ltd.,
C/o GAIL Training Institute, PARC Building,
Plot No. 24, Sector – 16A, Film City, NOIDA (U. P.)

40.5 Payment in R.A. bills shall based on quantity of work executed at site (as per the item of work) & verified by Owner/ Consultant as per the Contract. Owner/ Consultant is authorized to allow part rate/ reduced rate for any item as mentioned in Contract. The engineer in charge shall specify the reason for the part rate payment in the R.A. bill. Payment has been made in R.A. bill for any item but later on, if some defect is noticed by the Owner/ Consultant, then Owner/ Consultant shall disallow the payment in successive R.A. bill till rectification of the work has been done.

40.6 **RELEASE OF 1st R/A BILL**

Payment will be released against 1st R/A bill only on submission of following documents by contractor to the EIC/ OWNER:

- i. Contract Performance Security
- ii. Labour License (as per statutory requirements)
- iii. EPF Code Registration number with RPFC/ARPF
- iv. Insurance Contractor All Risk (CAR) Policy
- v. Workmen compensation policy

40.7 Balance 5% (Retention Money) shall be released along with final bill subject to the following:

If the amount recoverable exceeds the amount payable in final bill, the balance amount shall be recovered by the Owner, from the retention money and or performance bank guarantee/any other moneys or bank guarantees available with the owner for any other job being done by the contractor. The contractor shall restore the performance guarantee to the requisite value to the extent of 10% of contract price in such case where recovery is required to be affected by the encashment of full amount or a part of the performance bank guarantee as soon as the contractor receives such intimation from the owner/ consultant.

40.8 The contractor shall raise invoices on fortnightly basis. Bidder shall enclose all documents as per check list issued by CONSULTANT/TFL. However, EIC may authorize payments for bills more frequently i.e. periodicity of less than fortnight, depending on site requirements.

After receipt of complete R.A. Bill as per terms and conditions of the contract and duly certified by Engineer-in-Charge (EIC), on-account payment equivalent to seventy percent (70%) of the net payable certified amount of the R.A. Bill will be released to the Contractor within a period of seven (07) working days from submission of certified bill by EIC to OWNER. The balance amount will be released within a period of 15 days from submission of certified bill by EIC to OWNER.

However, in addition of Running Account Bill, the contractor has to submit the Monthly Progress Report. This report will acts as a mandatory document for submission of the bill. Failing in submission of the report, the invoice will not be processed further for payment

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40.9 The final bill complete in all respect shall be submitted by the contractor within three (3) months of certified completion of work. The bill should be accompanied along with the following documents.

1. Job completion certificate.
2. No claim certificate on Owner's prescribed proforma.
3. Site clearance certificate.
4. Contract Performance Security duly amended to cover Defect Liability Period.
5. Material reconciliation statement (statement of material issued by Owner or consultant to be got certified from stores dept.).
6. Indemnity certificate towards labour payment and all statutory payments.

No claim shall be entertained after receipt of final bill. Settlement of final bill shall be made subject to settlement of all disputes and furnishing of all required documents/clarifications and grant of extension of time, if any, by Owner's competent authority.

In case any claim with regard to the wages of any labour employed by Contractor for the subject job is pending/ reported, TFL shall be fully entitled to withhold payment of final bill pending finalisation of such claims.


41.0 DISPATCH, TRANSPORTATION/SHIPPING

41.1 CONTRACTOR shall be responsible for dispatch of EQUIPMENT by sea/ rail/ road/ air after proper packing and protection. The consignment shall be dispatched after inspection by concerned authority as specified in the Tender document, unless otherwise agreed to in writing however such inspection shall not constitute waiver of the CONTRACTOR's obligations, responsibilities for the EQUIPMENT including care, safety and preservation in any way and manner and the CONTRACTOR's responsibility and obligation in this behalf shall continue till ACCEPTANCE OF ENTIRE WORK.

The Consignee for all bought-out material shall be CONTRACTOR.

41.2 The Contractor, wherever applicable, shall after proper painting, pack and crate all equipment in such a manner as to protect them from deterioration and damage during rail and road transportation to the site and storage at the site till the time of erection. The Contractor shall be held responsible for all damages due to improper packing and handling.

- i) The Contractor shall notify Employer of the date of each shipment from his works, and the expected date of arrival at the Site for the information of Employer.
- ii) The Contractor shall also give all shipping information concerning the weight, size and content of each packing including any other information Employer may require.
- iii) The Contractor shall prepare detailed packing list of all packages and containers, bundles and loose materials forming part of each and every consignment dispatched to Site.
- iv) The Contractor shall further be responsible for making all necessary arrangements for loading, unloading and other handling right from his works up to the Site and also till the equipment is erected, tested and commissioned. He shall be solely responsible for proper storage and safe custody of all equipment.

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41.3 EMBOSSING/PUNCHING/CASTING

All equipment and materials supplied /erected under the works of 220kV Switching Substation (except 220kV U/G Cabling works) shall bear distinct mark of “OPTCL, PKG No. & Year” by a way of embossing / punching / casting. This should be clearly visible to naked eye.



42.0 WORK CONTRACT SERVICES

42.1 The award of work shall be on ‘Work Contract Service’ basis. The contractor shall be responsible for payment of any tax levied on the transfer of property and goods involved with relevant GST act and rules made there under including amendments, if any. The contractor shall be liable to ensure to have registered with the respective tax authorities and to submit self-attested copy of such registration certificate(s) and any taxes/ duties/ levies being charged by the Contractor would be claimed by issuing proper tax invoice/ challan indicating details/ elements of all taxes charged and necessary requirements as prescribed under the respective tax laws and also to mention correct and valid registration number(s) on all tax invoices raised to TFL.

42.2 Irrespective of single or separate insurances, the CONTRACTOR shall take the same in the joint name of OWNER and CONTRACTOR, with OWNER as Primary Beneficiary and CONTRACTOR as Joint Beneficiary, to cover all risk including marine cum erection insurance (MCE), workmen compensation / Employees State Insurance (ESI) under ESI Act 1948 for Contractor’s personnel, fire risk policy etc. till handing over of PLANT to OWNER duly commissioned and tested. However, for CONTRACTOR’s EQUIPMENT, CONTRACTOR can be the sole beneficiary. Further, OWNER shall have the first right over the claim amount for all insurance claims, where owner has made part or full payment to the contractor.

42.3 CONTRACTOR shall be fully responsible for pursuing and settling all claims under the underwriters. In the event of accident, injury, damage or loss likely to form a claim under the above insurance policies, CONTRACTOR shall, as quickly as possible submit the insurance claims by underwriters under intimation to OWNER. CONTRACTOR shall also keep OWNER fully informed about progress of each such case. CONTRACTOR shall undertake immediate repair and replacement of the equipment lost in transit, storage, assembly, erection and COMMISSIONING of PLANT pending settlement of claim thereafter by the underwriters.

42.4 The CONTRACTOR at his cost shall arrange, secure and maintain all insurance as may be pertinent to the works and obligatory in terms of law to protect his interest and interest of OWNER in the project, against all perils detailed herein. The Form and the limit of such insurance as defined herein together with the under-writer in each case shall be acceptable to the OWNER and OWNER’s acceptance shall not be unreasonably withheld. However, irrespective of such acceptance, the responsibility to maintain adequate insurance coverage at all times including third party liability during the period of contract shall be as of CONTRACTOR alone. The contractor’s failure in this regard shall not relieve him of any of his contractual responsibilities and obligations. The insurance covers to be taken by the CONTRACTOR shall be in the joint names of OWNER and the CONTRACTOR. The CONTRACTOR shall, however, be authorized to

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deal directly with insurance company or companies and shall be responsible in regard to maintenance of all insurance covers.

- 42.5 Any loss or damage to the equipment during handling, transportation, storage, erection, putting the equipment into satisfactory operation and all activities to be performed till the successful completion of trial operation of the plant shall be to the account of the CONTRACTOR. The CONTRACTOR shall be responsible for reference of all claims and make good the damages or loss by way of repairs and/or replacement of the equipment, damaged or lost. The transfer of title shall not in any way relieve the CONTRACTOR of the above responsibility during the period of CONTRACT. The CONTRACTOR shall provide the OWNER with copies of all insurance policies and documents taken out by him in pursuance of the CONTRACT. Such copies of documents shall be submitted to the OWNER immediately after such insurance coverage. However, if Marine cargo insurance or Third party liability Insurance is a part of their global policies; insurer certificate (including the main terms of policy) shall be submitted by CONTRACTOR. The CONTRACTOR shall also inform the OWNER in the writing at least thirty (30) days in advance regarding the expiry/ cancellation and/or change in any of such documents and ensure revalidation, renewal etc. as may be necessary well in time. However adequacy, credibility and maintenance of Insurance policies is the sole responsibility of CONTRACTOR and CONTRACTOR shall keep the OWNER indemnified against any such failure.
- 42.6 If the material/ equipment or any portion thereof is damaged or lost during transit and handling, storage, erection, commissioning at site, the replacements of such material / equipment shall be effected by the CONTRACTOR within a reasonable time to avoid unnecessary delay in the COMMISSIONING of the EQUIPMENT and without waiting for realization of cost of damages from the insurance company, appointed by him for this purpose. This will not alter the schedule of commissioning & guarantee tests in any way.
- 42.7 All works and operations necessary to lift and to remove the material from port, warehouse, railway or other siding, factory or other places of delivery, loading, handling, transporting and unloading and safely stacking, placing or storing the same at approved godowns, yards or other place(s) of storage including lashing or other-wise securing or protecting the same in transit and during and in storage.
- 42.8 The CONTRACTOR shall maintain a day-to-day account of all materials indicating the daily receipt(s), consumption(s) and balance of each material and category thereof. Such account shall be in the format, if any, prescribed by the Engineer-in-Charge and shall be supported by all documents necessary to verify the correctness of the entries in the account. Such account shall be maintained at the CONTRACTOR MANAGER"s office and site(s) and shall be open for inspection and verification (by verification of documents in support of the entry as also by feasible verification of the stock) at all times by the Engineer-in-Charge with authority at all times without obstruction to enter into or upon any godown or other place(s) or premise(s) where the materials or any part of them are lying or stored and to inspect the same himself and or through his representative(s).

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42.9 The CONTRACTOR shall at all times be exclusively responsible for any and all losses, damages, deterioration, misuse, wastage, theft, or other application or misapplication or disposal of the materials or any of them contrary to the provisions hereof and shall keep the OWNER indemnified from and against the same and shall forthwith at its own cost and expenses replace any such material, lost, damaged, deteriorated, misused, wasted, stolen, applied, mis-applied and/or disposed as aforesaid with other material of equivalent quality and quantity delivered to site at the CONTRACTOR's risks and costs in all respects.



42.10 Notwithstanding anything herein provided, the CONTRACTOR shall be and remain solely and exclusively liable to repair, restore or replace, as the case may be, the materials damaged or destroyed as a result of any act or omission, notwithstanding the existence or otherwise of any policy(ies) of insurance aforesaid, with the intent that any policy(ies) of insurance aforesaid taken out by the CONTRACTOR or by the OWNER, on default by the CONTRACTOR, shall not anyway absolve the CONTRACTOR from his full liability up to and until issue of the Completion Certificate as provided for herein in respect of the works, the work(s) and all materials incorporated therein shall be and remain at the risks of the CONTRACTOR in all respects, including (but not limited to) accident, lightning, earth-quake, fire, storm, flood, tempest, riot, civil commotion and/or war or otherwise with respect to the materials, but shall constitute merely an additional security and not a substitution of liability.

42.11 If the CONTRACTOR shall default in replacing at the job site, free of any cost to the OWNER, any material lost, damaged, deteriorated, misused, wasted, short, stolen, misapplied or disposed of within the provisions hereof above, or shall fail to return to the OWNER any surplus material or empties within the provision hereof above, the CONTRACTOR shall be liable to pay to the OWNER the cost of such materials or empties delivered at OWNER's stockpile/ godown.

43.0 CONSTRUCTION EQUIPMENT, TOOLS AND TACKLES DEPLOYMENT

- i. The details of key construction equipment in good condition, required to be mobilized by the contractor, to complete the work within the schedule is listed below (not limited to only the following) :

Sl. No.	Equipment Description
1	Hydraulic Telescopic Boom Pick & Carry Crane of suitable capacity
2	Hydraulic Excavator
3	Dumper
4	Tractor Trailer
5	Water Tanker
6	Total Station
7	Dumpy level
8	Welding Machine
9	Dewatering Pump
10	Concrete Mixer
11	Electrical tool Kit
12	Breaker
13	Manual/ Electrical Lifting Equipment/ Hoists/ Pullers of suitable capacity
14	Any, other equipments to complete the job

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- ii. Contractor to confirm that the above equipments are available with him in good working condition and shall be timely mobilized on this project site. Contractor has the option to hire some these equipment from equipment hiring agencies also, however contractor shall be responsible for all the machinery deployed at site.
- iii. In addition to above, Contractor shall be required to deploy all the machinery/ tools & tackles at site as required for the successful completion of the job/ as directed by the Engineer-in-charge.
- iv. Owner/ consultant reserve the right to physically check & verify the availability of these equipments prior to award of work
- v. Contractor shall replace any defective/ damaged equipment promptly to complete the work without any time & cost implication to the owner/ consultant
- vi. The actual deployment of equipments shall be finalized or approved by Engineer-in-charge.

44.0 STATUTORY VARIATION IN TAXES AND DUTIES

- 44.1 No variation on account of taxes and duties, statutory or otherwise, (other than due to change in turnover) shall be payable by OWNER to CONTRACTOR, except for GST. Any statutory variation in GST, shall be payable up to COMPLETION PERIOD against documentary evidence. Any reduction in the amount of GST resulting from a reduction in the rate of GST or remission or exemption from GST with respect to Goods and Services provided to the OWNER shall be refundable to the OWNER at actuals within the COMPLETION PERIOD and also during the delayed contractual Project completion, if any. The CONTRACTOR shall submit a copy of the 'Government Notification' to evidence the rate as applicable on the Bid due date and on the date of revision.
- 44.2 Any new taxes, duties, cess, levies notified or imposed after the submission of Price Bid but before COMPLETION PERIOD shall be to OWNER's Account.
- 44.3 In case of delayed completion beyond the COMPLETION PERIOD, even though extension of completion time is allowed by OWNER, for reasons solely attributable to Contractor, all extra costs on account of changes of statutory regulations/ acts, or shall not apply to the Contract price and shall be borne by the CONTRACTOR.

However, any decrease in taxes and duties during the delayed period shall be passed on to the OWNER.

In case the COMPLETION PERIOD is extended for reasons solely attributable to OWNER, then any increase on account of statutory changes in GST until the extended period shall be borne by OWNER. Further, any new taxes, duties, cess, levies notified or imposed after the submission of Price Bid during such extended COMPLETION PERIOD shall be to OWNER's Account-
- 44.4 Claim for payment of GST (CGST & SGST/UTGST or IGST)/ Statutory variation, should be raised within two [02] months from the date of issue of 'Government Notification' for payment of differential (in %) GST (CGST & SGST/UTGST or IGST), otherwise claim in respect of above shall not be entertained for payment of arrears.

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The base date for the purpose of applying statutory variation shall be the Bid Due Date.

44.5 BOCW (BUILDING AND OTHER CONSTRUCTION WORKS)

Applicable BOCW shall be included in the quoted TOTAL CONTRACT PRICE. The contractor shall pay the cess under BOCW Act for subject works and submit proof of submission of cess to owner before submitting the next R.A. bill. In case, contractor does not submit the said proof, applicable BOCW shall be deducted at source by the OWNER from the contractor's invoice and deposit the deducted amount to the concerned authority. OWNER does not undertake any further responsibility in this regard.

45.0 STATUTORY APPROVAL

- 45.1 Unless otherwise specified in the Bidding Document, it shall be the CONTRACTOR'S sole responsibility to obtain all approvals from any authority required under any statute, rule or regulation of the Central or Odisha State Government for the performance of the contract and / or the contractual work. The application on behalf of Employer for submission to relevant authorities along with copies of required certificates complete in all respects shall be prepared and submitted by the CONTRACTOR well ahead of time so that the actual construction / commissioning of the works is not delayed for want of the approval / inspection by the concerned authorities. The CONTRACTOR shall arrange for the inspection of the works by the authorities and will undertake necessary coordination and liaison required and shall not be entitled to any extension of time for any delay in obtaining such approvals.
- 45.2 Statutory fees, if any, paid for all such inspection and approvals shall be reimbursed at actual to the CONTRACTOR by Employer on production of documentary evidence.
- 45.3 Any deficiency (ies) as pointed out by any such authority shall be rectified by the CONTRACTOR within the scope of relative supply and / or work at no extra cost to Employer. The inspection and acceptance of the work by such authorities shall, however, not absolve the CONTRACTOR from any of its responsibilities under this contract.

46.0 SUB-CONTRACTOR/VENDOR AND MANUFACTURER WARRANTIES

- (a) CONTRACTOR shall ensure that all equipment and other items used in connection with the performance of the WORK or incorporated in the PLANT (other than minor items) will be purchased in compliance with CONTRACT Technical Specifications and requirements in order to allow the PLANT to achieve the Guarantee and Warrantee as provided for in the CONTRACT, unless otherwise agreed with OWNER. Any residual warranty from sub-contractor/vendor shall be passed to the OWNER after expiry of DEFECT LIABILITY PERIOD.
- (b) Neither CONTRACTOR nor its SUB-CONTRACTORS/SUB-VENDORS nor any person under the control of either thereof, shall take any action which could release, void, impair or waive any Guarantee or Warranty on EQUIPMENT or services relating to the PROJECT or the WORK. Any residual warranty from sub-contractor/sub-vendor shall be passed to the OWNER after expiry of DEFECT

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LIABILITY PERIOD.

- (c) Nothing in this clause shall derogate from the obligations of CONTRACTOR to provide the Guarantees and Warranties described in and to comply with the provisions hereinabove.
- (d) CONTRACTOR shall, based on its past professional judgement, enforce all guarantees and warranties provided hereunder to the fullest extent thereof till such time they are transferred to the OWNER pursuant to sub-clause (g) below.
- (e) Upon the expiration or termination of any of the guarantees or warranties provided by CONTRACTOR pursuant to the CONTRACT, the CONTRACTOR shall assign, and hereby assigns, effective as of such date, or otherwise make available, to OWNER all of CONTRACTOR's rights under all such SUBCONTRACTOR's residual Guarantees and warrantee as per 45.0 (a) & (b) (except to the extent CONTRACTOR has thereof provided warranty services to OWNER and is enforcing CONTRACTOR's rights with respect to such services under the applicable guarantee or warranty) and shall deliver to OWNER copies of all contracts providing for such guarantees and warranties.
- (f) CONTRACTOR, in accordance with the CONTRACT, shall require all SUB-CONTRACTORS/ SUB-VENDORS to be covered by the insurance covers specified in the CONTRACT, during the time in which they are engaged in performing WORK.
- (g) CONTRACTOR shall require all SUB-CONTRACTORS/ SUB-VENDORS to release and waive any and all rights of recovery against OWNER including its affiliates, subsidiaries, employees, successors, permitted assigns, insurers and underwriters) and against CONTRACTOR and all other SUB-CONTRACTORS/ VENDORS which the releasing SUB-CONTRACTOR/ VENDOR may otherwise have or acquire, in or from or in any way connected with any loss covered by policies of insurance maintained or required to be maintained pursuant to this the CONTRACT (other than third party liability insurance policies) or because of deductible clauses in or inadequacy of limits of any such policies of insurance. CONTRACTOR shall further require all SUB-CONTRACTORS/VENDORS to include in all policies of insurance maintained by the SUB-CONTRACTORS/VENDORS clauses providing that each underwriter shall release and waive all of its rights of recovery, under subrogation or otherwise, against OWNER, its promoters, affiliates, subsidiaries, employees, successors, permitted assigns, insurers and underwriters, and against CONTRACTOR and all other SUB-CONTRACTORS/VENDORS.
- (h) OWNER shall not be deemed by virtue of the CONTRACT to have any contractual obligation to or relationship with any SUB-CONTRACTOR/ VENDOR.

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47.0 CONTRACTOR'S LIABILITY FOR APPROVED SUB CONTRACTOR :

The review by and approval and consent of OWNER as to the approved SUB-CONTRACTORS list or as to CONTRACTOR entering into any SUB-CONTRACT with any approved SUB-CONTRACTOR or as to any WORK done or supply made or services provided by any such approved SUB-CONTRACTOR/ SUB-VENDOR shall not relieve CONTRACTOR of any of his duties, liabilities or obligations under this CONTRACT, and CONTRACTOR shall be liable hereunder to the same extent as if any such SUB-CONTRACT had not been entered into. Any inspection review or approval by OWNER permitted under this CONTRACT of any portion of the work or of any work in progress by CONTRACTOR or SUB-CONTRACTORS/ SUB-V ENDORS shall not relieve CONTRACTOR of any duties, liabilities or obligations under this CONTRACT.

48.0 FUNCTIONAL GUARANTEES

Bidder shall state the guaranteed technical particulars, performance or efficiency of different equipment/materials with respect to the Technical Specifications. Equipment/Materials offered shall have guaranteed acceptable particulars /performance/efficiency specified in Technical Specification.

49.0 TRIAL OPERATION:

For Trial Operation, the system for a particular package, Sub-Station and Line shall be energized in presence of the representative of OPTCL and same shall be maintained in energized condition for a period of at least twenty-four (24) hours. In case of any defect is observed, then such mutually agreed defect shall be liquidated within a maximum period of one week by the bidder. Thereafter, the system shall be maintained in energized condition.

50.0 PLANNING AND DESIGNING IN PURVIEW OF VULNERABILITY ATLAS OF INDIA

Vulnerability Atlas of India (VAI) is a comprehensive document which provides existing hazard scenario for the entire country and presents the digitized State/UT- wise hazard, maps with respect to earthquakes, winds and floods for district-wise identification of vulnerable areas. It also includes additional digitized maps for thunderstorms, cyclones and landslides. The main purpose of this Atlas is its use for disaster preparedness and mitigation at policy planning and project formulation stage.

This atlas is one of its kind single point source for the various stakeholders including policy makers, administrators, municipal commissioners, urban managers, engineers, architects, planners, public etc. to ascertain proneness of any city/location/site to multi-hazard which includes earthquakes, winds, floods thunderstorms, cyclones and landslides. While project formulation, approvals and implementation of various urban housing, buildings and infrastructures schemes, this Atlas provides necessary information for risk analysis and hazard assessment.

The Vulnerability Atlas of India has been prepared by Building Materials and Technology Promotion Council under Ministry of Housing and Urban Affairs, Government of India and available at their website www.bmtpc.org.

It is mandatory for the bidders to refer Vulnerability Atlas of India for multi hazard risk assessment and include the relevant hazard proneness specific to project location while planning and designing the project in terms of

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- i. Seismic zone (II to V) for earthquakes,
- ii. Wind velocity (Basic Wind Velocity: 55, 50, 47, 44, 39 & 33 m/s)
- iii. Area liable to floods and Probable max, surge height
- iv. Thunderstorms history
- v. Number of cyclonic storms/severe cyclonic storms and max sustained wind specific to coastal region
- vi. Landslides incidences with Annual rainfall normal
- vii. District wise Probable Max Precipitation.

51.0 STANDARD CONDITIONS OF SCC: PART I TO PART III

The Contractor has to fully comply with all applicable Labour Laws and Regulations passed, modified and notified from time to time by the Central, State and Local Government agencies/authorities. Brief guidelines and Annexures related to labour laws/Acts for Workmen/labour are enclosed as STANDARD CONDITIONS OF SCC: PART I to PART III.

52.0 ADDITIONAL PERFORMANCE BANK GUARANTEE FOR MAJOR EQUIPMENTS:

52.1 A separate Bank Guarantee (Equipment Performance BG) for **10%** of the cost (including GST) of **S/S Automation Equipment, FOTE/OLTE equipment, Cables, CT, PT, Breakers, Structures** shall be submitted by the successful Bidder 01 (One) Month prior to expiry of the '10% Contract Performance Security'. which will be valid for 3 (Three) Months over and above the additional Guarantee Period beyond the guarantee period of such major items i.e. (36 months + 3 Months = 39 months).



Additionally, a separate Bank Guarantee (Equipment Performance BG) for **10%** of the supply cost of the **Power Transformers** and **GIS Equipment** and associated materials (including GST) shall also be submitted 01 (One) Month prior to expiry of the '10% Contract Performance Security', which will be valid for 63 (Sixty-Three) Months over and above the Contract Performance Security.

The validity of Additional Bank Guarantee shall be beyond the Contract Performance Guarantee period of the Project and shall be as hereunder;

- i. **36 Months + 3 Months = 39 months for S/S Automation Equipment, FOTE/OLTE equipment, Cables, CT, PT, Breakers, Structures.**
- ii. **60 Months + 3 Months = 63 months for Power Transformer and GIS Equipment and associated materials**

52.2 If the work completion period gets extended the Contract Performance Bank Guarantee shall be extended accordingly. In case the contract price gets revised, the successful bidder shall submit the amended Bank Guarantee to that effect.

52.3 The above mentioned Equipment Specific Bank Guarantees shall be submitted (Original and two nos. of copies) to "**TALCHER FERTILIZERS LIMITED**" for acceptance. However, on scrutiny if any deficiency is observed to the said CPBG, the contractor shall be intimated about such deficiency to resubmit the fresh BG and /or amended BG in lieu of the Original BG. However, the fresh / amended BG shall be submitted within the time

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schedule. Despite above, if the BG is not submitted or it is still not acceptable to “TALCHER FERTILIZERS LIMITED” necessary action as per the contract shall follow.

52.4 The aforesaid Bank Guarantees shall be returned to the Contractor after successful completion of the guaranteed obligations under the contract.

53.0 GUARANTEE/WARRANTY:

53.1 The Contractor shall guarantee that the equipment/materials will be new, unused and in accordance with the Contract documents and free from defects in material and workmanship for a period of 12 (Twelve) months commencing immediately after the satisfactory commissioning of the entire works under the contract. The Contractor's liability shall be to the extent of repair/replacement of such defective equipment/material either arising from faulty design or defective equipment/materials and/or bad workmanship. Such defective equipment/materials shall be handed over to the Contractor for repair or replacement by a new one, unless otherwise repairable at site. The Contractor shall complete the repair/replacement work within the reasonable time frame intimated by the Engineer-In-Charge.

If any defects are not remedied within the time frame, the Engineer-In-Charge may proceed to do the work at the Contractor's risk and cost but without prejudice to any other rights, which “**TALCHER FERTILIZERS LIMITED**” may have against the Contractor in respect of such defects.

53.2 If it becomes necessary for the Contractor to replace or renew any defective portions of the works the provision of this clause shall apply to portion of the works so replaced or renewed until the expiry of guarantee period.

53.3 The repaired or new parts will be supplied and erected free of cost by the Contractor. If any repair is carried out on his behalf at the site, the Contractor shall bear the cost of such repairs.

53.4 The cost of any special or general overhaul rendered necessary during the maintenance period due to defects in the equipment or defective work carried out by the Contractor, the same shall be borne by the Contractor.

53.5 The acceptance of the equipment or works by the Engineer-In-Charge shall in' no way relieve the Contractor of his obligations under this clause.

53.6 In the case of those defective parts, which are-not repairable at site but are essential for the operation of the equipment, the Contractor and the Engineer-In-Charge shall mutually agree to a program of replacement or renewal, which will minimize interruption to the maximum extent in the operation of the equipment.

53.7 At the end of the guarantee period, the Contractor's liability ceases except for latent defects.

STANDARD CONDITIONS OF SCC: PART I

Compliances under various Labour Laws

The Contractor has to fully comply with all applicable Labour Laws and Regulations passed, modified and notified from time to time by the Central, State and Local Government agencies/authorities. Specific attention of the Contractor is drawn to the following obligations amongst others:

1. **The Minimum Wages Act, 1948, Payment of Wages Act, 1936 and Payment of Bonus Act 1965 or The Code on Wages, 2019 (after it comes into force)**

1.1. **Minimum Wages:**

- a. During the tenure of the contract, the Contractor must ensure the payment of minimum wages, as notified by the Central Government or State Government whichever is higher, as per the provisions of the Minimum Wages Act, 1948 / Code on Wages, 2019 (after it comes into force).
- b. **Wage period and monthly wages:** Wage period shall be monthly and wages for a month shall be calculated by multiplying daily rate of Minimum Wages by 26. The monthly wages include the wages of the weekly days of rest as applicable to the office/establishment of TFL. Deduction in case of any days of absence other than weekly days of rest shall be calculated using the following formula:

Deduction for absence = days of absence x (monthly wages / number of days in the relevant month)

However, in case the resource has worked for less than 7 working days in a particular month, the payment of wages is to be made as per the actual number of days worked based on notified wage rate per day.

Illustration I (05 days per week working pattern):

Sl. No.	Month	Nos. of days in the month	Nos. of weekly off	Nos. of days absence	Nos. of days present	Daily wage as notified	Monthly wage	Deduction	Wage to paid
1	Feb.	28	8	2	18	603	15678	1119.86	14558.14
2	March	31	10	5	16	603	15678	2528.71	13149.29
3	April	30	8	10	12	603	15678	5226	10452.00
4	May	31	10	-	4	603	2412	0	2412.00

Illustration II (06 days per week working pattern):

Sl. No.	Month	Nos. of days in the month	Nos. of weekly off	Nos. of days absence	Nos. of days present	Daily wage as notified	Monthly wage	Deduction	Wage to paid
1	Feb.	28	4	2	22	603	15678	1119.86	14558.14
2	March	31	5	5	21	603	15678	2528.71	13149.29
3	April	30	4	10	16	603	15678	5226	10452.00
4	May	31	5	-	4	603	2412	0	2412.00

1.2. Payment of Wages:

The Contractor shall disburse monthly wages **through e-banking / digital mode through cashless transaction only**, and avoid illegitimate deductions and maintain records /returns as prescribed. The Contractor shall be solely responsible for the payment of wages and other dues to the resources, if any, deployed by him latest by 7th day of the subsequent month as per the provisions of the Payment of Wages Act, 1936 / as applicable under Code on Wages, 2019 (after it comes into force) in the presence of Engineer In-charge (EIC) or authorized representative of TFL. After disbursement of wages, the representative of the Contractor and EIC/ authorised representative of TFL have to certify the payment of wages to the resources and sign the Wage Register - Form B (under The Ease of Compliance to Maintain Registers under various Labour Laws Rules, 2017) / FORM-I of Code on Wages, 2019 (after it comes into force) with specific seal detailing name/designation/Company.

1.3. Payment of Bonus:

Contractor shall ensure payment of bonus as per the provisions of the Payment of Bonus Act, 1965 / Code on Wages, 2019 (after it comes into force). Present minimum rate of payment of Bonus as per the Payment of Bonus Act, 1965 is 8.33% of minimum wages per month or 8.33% of Rs.7,000/- per month whichever is higher. The rate shall be subject to amendments made from time to time to the legislation.

Payment of Bonus / ex-gratia (if Bonus is not applicable) shall be made preferably before Deepawali festival falling after the end of relevant financial year(s) and the balance payment at the time of closure of contract.

The amount towards the payment of bonus/ex-gratia shall be released / reimbursed to the contractor, after submission of proof of payment.

2. Leaves/ Leave with wages/ Holiday:

The Contractor shall comply with all the applicable leave Rules including leave with wages in terms of applicable labour legislations i.e. Factories Act, 1948 / Shops & Establishment Act/ Industrial Establishment (national & festival holidays, casual & sick leave) Act, 1965.

The Contractor shall extend the leave with wages and maintain the Register of Leave pertaining to the resource deployed. The payment towards un-availed leave, as per the Factories Act, 1948

/ Shops & Establishment Act, shall be settled with the resource at the time of closure of the contract or separation of resource from the contract by the contractor.

- i. As per the **Factories Act, 1948 (if applicable)**:-Annual Leave with Wages @ 01 day for every 20 days of work performed by him in the previous calendar year becomes due.
- ii. As per the **Shops & Establishment Act (if applicable)** : Privilege Leave not less than 15 days and Sickness/Casual Leave not less than 12 days (this provision may vary from state to state).
- iii. As per the **Industrial Establishment (national & festival holidays, casual & sick leave) Act, 1965 (if applicable)**: (a) three national holidays of one whole day each on the 26th January, 15th August and 2nd October (b) five other holidays on any of the festivals specified in the - Schedule appended to this Act. (c) Every worker shall in each calendar year, be allowed by the employer 07 casual leave and 14 sick leave in such manner and on such conditions as may be prescribed (This provision may vary from state to state).

3. The Employees' Provident Fund & Miscellaneous Provisions Act 1952

- a) The Contractor shall have independent PF code no. with the RPFC as required under the Employees' PF & Misc. Provisions Act, 1952.
- b) The Contractor has to ensure compliance (as per prevailing rates) and extend benefits under the Employees' Provident Fund Scheme 1952, the Employees' Pension Scheme 1995 & the Employees' Deposit Linked Insurance Scheme, 1976 to the resources deployed by him.
- c) The Contractor is required to submit copies of *separate e-Challans / ECR alongwith proof of payment/receipt* in respect of resources engaged through this contract only, on monthly basis. **Common challans would not be acceptable in TFL.** The Contractor should submit copies of previous months EPF e-Challans / ECR alongwith current month's bill. The TRRN. No. of the ECR would be verified online from EPFO portal by the Engineer-in-charge to confirm the status of payment and names of the resources deployed.
- d) **PF is mandatory irrespective of the number of resources deployed** by the Contractor under this contract. **PF membership and deposit of PF contribution is also mandatory even if the wage payment to the resource is exceeding the prescribed monthly wage ceiling (i.e. Rs. 15,000/-) under the Employees' PF & Misc. Provisions Act, 1952 and in such case the liability of the Contractor towards PF contribution shall be limited to the prescribed monthly wage ceiling notified from time to time (i.e. Rs. 15,000/- currently).**
- e) In case, the Contractor deploys any "**International Worker**", the Contractor should also make compliance under para 83 of EPF Scheme, 1952 i.r.o the "International Workers" and must register on the ***International Worker Portal of EPFO.***

4. The Employees' State Insurance Act, 1948 (If applicable and as per prevailing rates)

- a) The Contractor shall have his own ESI code No. allotted by Employees' State Insurance Corporation (ESIC) as required under the Employees' State Insurance Act, 1948.
- b) The Contractor has to arrange **Smart Cards (i.e. ESI Identity Card) /e-Pehchan Card** for the resource(s) engaged by him from the Corporation.

5. The Employees' Compensation Act 1923 (wherever applicable)

In case, the work place is out of the notified coverage area under ESIC i.e. ESIC is not implemented in the area **or** in case of excluded employees under ESIC, the Contractor is required to take Employee Compensation / Workmen Compensation Policy from IRDAI approved Insurance Company taking into consideration the **maximum compensation liability** as per provisions of Employees' Compensation Act, 1923. It must be ensured that the contractor/contracting firm should extend coverage to the contract workers through Employee Compensation Policy, to meet the **Compensation Liability** under **Employee's Compensation Act, 1923** along with **Medi-claim Policy** within the overall premium @ 3.25 % of Minimum wages (i.e. employer contribution towards ESI).

6. Group Personal Accident Insurance Policy

The Contractor is required to take a Group Personal Accident Insurance Policy with coverage of **Rs. 3 Lakhs** per resource for the entire period of contract covering all resources deployed under the contract.

7. The Payment of Gratuity Act, 1972

In case of Death or permanent disablement of a resource during execution of work under the contract, the Contractor has to pay the Gratuity as per the provision under the Payment of Gratuity Act, 1972 to the nominee(s) of the resource as per the details maintained in the duly signed Nomination Form maintained by the Contractor. The proof of disbursement may be submitted to the EIC for claiming reimbursement of amount paid towards death Gratuity from TFL.

8. The Contract Labour (R&A) Act, 1970

- a) The Contractor is required to obtain Labour license under the provisions of the Contract Labour (R&A) Act, 1970 from the office of Licensing Officer, Central Labour Authority, Ministry of Labour and Employment, Govt. of India having jurisdiction of the Region.
- b) The Contractor shall discharge obligations as provided under the Contract Labour (R&A) Act, 1970 rules and regulations framed under the same and enforced from time to time.
- c) The Contractor shall ensure regular and effective supervision and control over the resources deployed for which a supervisor / representative of the Contractor should be available at all the times for giving suitable direction for undertaking the Contractual Obligations.
- d) The Contractor is solely responsible for payment of wages to each resource deployed by him and such wages shall be paid before the expiry of such period as may be prescribed.
- e) It shall be the duty of the Contractor to ensure the disbursement of wages to resource(s) through e-banking/digital mode. In case the resource does not have a bank account, the disbursement of wages may be made in cash in the presence of the Engineer-in-charge /

authorized representative of TFL initially and Contractor shall simultaneously arrange for opening the bank account of each contract labour deployed by him.

- f) In case, the Contractor fails to make payment of wages and deposit of PF contribution within the prescribed period or makes short payment of wages / short deposit of PF contribution, then TFL, as Principal Employer, will make payment of wages in full or the unpaid balance due, as the case may be, to the resource(s) deployed by the Contractor and deposit the PF contribution with PF authorities. Such amounts will be recovered from the Contractor either by deduction from any amount payable to the Contractor under any contract or as a debt payable by the Contractor.
9. The contractor is required to comply with all applicable labour laws and regulations including, but not limited to the following:
- a) The Factories Act, 1948 / The Shops & Establishment Act, 1948 (which ever applicable)
 - b) The Maternity Benefit Act, 1961
 - c) The Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act 1979 & Building and Other Construction Workers Welfare Cess Act, 1996
 - d) The Inter State Migrant Workmen (RECS) Act 1979 (if applicable)
 - e) Contract Labour (R&A) Act-1970
 - f) Employees' Provident Fund & Misc. Provisions Act- 1952
 - g) Employees' State Insurance Act-1948
 - h) Employees' Compensation Act, 1923
 - i) Payment of Gratuity Act, 1972
 - j) Minimum of Wages Act,1948
 - k) The Payment of Wages Act,1936
 - l) The Payment of Bonus Act,1965

STANDARD CONDITIONS OF SCC: PART II

Responsibilities of the Contractor

1. The Contractor shall be solely responsible and indemnify TFL against all charges, dues, claim etc. arising out of the disputes relating to the dues and employment of resources, if any, deployed by him.
2. The Contractor shall indemnify TFL against all losses or damages, if any, caused to it on account of acts of the resource(s) deployed by him.
3. The Contractor shall indemnify TFL from all claims, demands, actions, cost and charges etc. brought by any court, competent authority / statutory authorities against TFL.
4. The Contractor shall also indemnify TFL for any action brought against him for violation, non-compliance of any act, rules & regulation of center / state / local statutory authorities.
5. All resources deployed by the Contractor are deemed to be on the rolls of the Contractor.
6. **Age:** No resource below the age of **18 years** and above age of **58 years** shall be deployed by the contractor for the execution of the contract.
7. **Appointment/Nomination of supervisor:**
As a part of the contract, the Contractor is required to appoint/nominate a supervisor (s) who will supervise, control and give directions to the resource(s) for discharging the contractual obligations. Accordingly, the Contractor has to give in writing the name and contact details of the supervisor (s) to the EIC. A copy of the same is also to be sent to HR In-charge and Security In-charge for records.
8. A copy of the Letter of Acceptance (LOA) should be submitted to the Security Department by the Contractor / his representative or supervisor for facilitating the movement of resource(s) including machine & materials involved in the contract.
9. The resources to be deputed/ deployed by the Contractor shall observe all security, fire and safety rules of TFL while at the site/work. All existing and amended safety / fire rules of TFL are to be followed at the work site by the Contractor and his deployed resource(s).
10. **Personal Protective Equipment / Safety Kit and Liveries:** Contractor shall ensure adequate supply of personal protective equipment / Safety Kit and Liveries as mentioned in the Scope of Work to all such resources deployed.
11. In case of accident, injury or death caused to the resource(s) while executing the Work under the contract, the Contractor shall be solely responsible for payment of adequate compensation, insurance money etc. to the next kith & kin of injured / diseased. Contractor shall indemnify TFL from such liabilities.
12. The Contractor shall not deploy any resource suffering from any contagious or infectious disease. The Contractor shall get the deployed resource(s) examined from a civil Govt. Doctor / TFL's Doctor.

13. No resource(s) or representatives of Contractor (including Contractor) are allowed to consume alcoholic drinks or any narcotics within the premises of TFL (including Plant, Office and Residential etc.). If found under the influence of above, the Contractor shall immediately replace that resource(s) with intimation to the EIC.
14. While engaging / deploying the resources, the Contractor is required to make efforts to provide opportunity of employment to resources belonging to **Schedule Caste, Schedule Tribe and Other Backward Class** in order to have a fair representation of these sections of the society.
15. While engaging the resources, the Contractor is required to make efforts to provide an **opportunity to** candidates with experience of **apprentice training in TFL** under the provisions of the Apprentices Act, 1961.
16. The Contractor is required to maintain all Registers and other records in an **office** within the premises of TFL or at a place **within a radius of three kilometers**.
17. Contractor shall provide proper **Employment cards (FORM XII)** for the resource to be deployed by him, duly signed by the Contractor or authorized person on behalf of Contractor.
18. **Gate/ Entry Pass or Authorization:**
Entry to the premises of TFL is restricted and is subject to appropriate entry authorization in the prescribed format of a Gate Pass or any other entry authorization w.r.t police verification as per instruction of Security department from time to time. Similarly, entry for material/equipment's/ tools/ tackles etc. is restricted & subject to entry authorization by security department.
19. The Contractor shall issue **Identity cards** in his firm's name to the resource deployed.
20. Discipline of the resource(s) during discharge of duties must be regulated by the Contractor himself or by his representative.
21. **Police verification**
 - a) The Contractor (including his sub-Contractors/Petty Contractors etc, if allowed) will undertake police verification in respect of the resource(s) engaged by him in TFL's premises. Such verification will have to be carried out from concerned police station of their permanent place of residence/present place of residence.
 - b) Further, the Contractor is advised not to deploy any resource having past criminal record in the establishment/premises of TFL under this contract awarded to him.
 - c) In the event of violation of above clauses at (a) and (b), the Contractor will be solely responsible for the same.
 - d) If any such resource(s) having criminal record is deployed by the Contractor in the premises of TFL and has come to the notice of TFL at any point of time, the Contractor shall immediately replace that resource(s), failing which that particular resource(s) of the Contractor will not be allowed to enter into the premises of TFL.
22. While confirming to any of these conditions, the Contractor must ensure that all applicable Laws of State regarding labour, their welfare, conduct etc. are complied.

STANDARD CONDITIONS OF SCC: PART III

Compliance of Government of India Directives

1. Pradhan Mantri Suraksha Bima Yojna (PMSBY) and Pradhan Mantri Jeevan Jyoti Bima Yojna (PMJJBY)

Contractor shall, ensure that all its resources deployed under this contract have obtained additional insurance coverage under the Pradhan Mantri Suraksha Bima Yojana (PMSBY) and Pradhan Mantri Jeevan Jyoti Bima Yojana (PMJJBY) through the participating banks and submit the proof of such insurance coverage to the satisfaction of TFL. The cost has been included in the estimate mentioned in SOR and the Contractor shall submit evidence / proof to TFL in this respect. Both the schemes are to be regulated continuously on yearly basis and the same should be renewed on each successive relevant date in subsequent years during the period of the contract.

2. Labour Identification Number (i.e. LIN) Registration (Mandatory)

The Unified Shram Suvidha Portal, developed by Government of India, facilitates reporting of Inspections & submission of Returns and has also been envisaged as a single point of contact between employer, resources and enforcement agencies bringing in transparency in their day-to-day interactions. For integration of data among various enforcement Agencies, the Contractor, as an inspectable unit, is required to register and obtain Labour Identification Number (i.e. LIN) from Shram Suvidha Portal and submit the same in TFL.

3. Pradhan Mantri Rojgar Protsahan Yojna (PMRPY) – if applicable

In order to support the Govt. of India's Initiative on Employment Generation, the Contractor must register for Pradhan Mantri Rojgar Protsahan Yojna (PMRPY) Scheme. The Contractor shall inform TFL/Engineer in Charge about the benefit availed, if any, against the scheme for adjustment against the invoice(s) / bill(s).

Details in support of RA Bill for the Month of _____, 20__

- (1) Name of the Firm/Agency/Contractor _____
- (2) Nature of Contract: Job/ Service _____
- (3) Period of Contract: From _____ to _____
 - (a) Extension Period of Contract, if any from _____ to _____
 - (b) Place where contract workmen are working _____
- (4) Postal address of the Contractor: _____
- (5) Phone No. of the Contractor: _____
- (6) Fax No. and Email of the Contractor: _____
- (7) Name and Address of PF office from where EPF Code No. has been allotted: _____
- (8) EPF Code No. allotted by PF office: _____
- (9) Name and Address of ESIC office from where ESI Code No. has been allotted: _____
- (10) ESI Code No. allotted by ESIC office: _____
- (11) Labour License No. _____ dated _____
- (12) Validity period of Labour License from _____ to _____
- (13) Detail of Resource engaged by the Contractor:

Category	No. of Resources		Prevailing Minimum Wages
	Male	Female	
Unskilled			
Semi-skilled			
Skilled			
Highly skilled			
Total			

- (14) Copy of Wage Register in FORM – B (to be replaced by FORM-I as per Code on Wages-2019, after it comes into force)
- (15) Details of deposit of contribution towards EPF:
 - a) EPF Challan No. _____ Amount _____ Date _____
- (16) Details of Deposition of contribution towards ESI
 - a) ESI Challan No. _____ Amount _____ Date _____
- (17) Whether any arrangement / agreement has been entered with any resource for extending benefits under Inter-state Migrant Workmen (RE&CS) Act, 1979: ____ (Yes / No)
If Yes, No. of such Inter-state Migrant Workers: _____

SIGNATURE OF CONTRACTOR/AUTHORIZED REPRESENTATIVE

Place:
Date:

UNDERTAKING

(To be submitted along with un-priced bid)

I/We hereby undertake that I/We have completely understood the terms & conditions of the Tender including minimum resources required to be deployed and the cost involved thereof in deployment of resources.

I/We further undertake to ensure all compliances of the tender conditions. Any non-compliance may be construed as deficiency in the performance of the contract. If such non-compliance is noticed TFL/owner is at liberty to take action in line with the tender conditions including termination of the contract.

Signature of Bidder.....

Name of Bidder.....

Summary of Insurance Policies

Contractor is required to cover all resources deployed by him with the following insurances / schemes:

Sl. No.	SCHEME	APPLICABILITY	PREMIUM/ CONTRIBUTION	SUM ASSURED/ BENEFITS	REMARKS
1	The Employees' State Insurance Act, 1948	Applicable to all resources of the Contractor (within ESI wage limit) working in notified area.	3.25% of wages by employer 0.75% of wages by employees	Benefits under the Employees' State Insurance Act, 1948.	
2	The Employees' Compensation Act, 1923 (in lieu of ESI – mentioned at Sl. 1)	Applicable to excluded employees under ESI and those who are working in non-notified area to extend similar benefits as available under ESI Act, 1948	Premium to be calculated considering wage limit under EC Act, 1923 (i.e. Rs. 15,000/- p.m currently)	Maximum Compensation Liability under Employee's Compensation Act, 1923 along with a Mediclaim policy within overall premium @ 3.25 % of Minimum wages (i.e. employer contribution towards ESI)	Provides compensation and medical facility to resources.
3	Group personal Accident Insurance	Applicable to all resources of the Contractor	Based on the coverage	Insured value: Rs. 3 Lakh to cover expenses associated with any accident.	Death, permanent disablement, temporary total disability or any other medical expenses related to accident.
4	Pradhan Matri Suraksha Bima Yojana (PMSBY)	Eligibility – age group 18 to 70 years	Rs. 12/- per annum	Accidental death and permanent disability: (i) Permanent total disability – Rs. 2 lakhs. (ii) Permanent partial disability – Rs. 1 Lakh.	
5	Pradhan Mantri Jeevan Jyoti Bima Yojana(PMJJB)	Eligibility – age group 18 to 50 years. (can continue upto 55 years)	Rs. 330/- per annum.	Risk coverage – Rs. 2 Lakhs- in case of death due to any reason	

 पी डी आई एल PDIL	PROJECTS & DEVELOPMENT INDIA LIMITED	PC-183/ E-4024/ S-V	0	 Talcher Fertilizers
		DOC. NO.	REV.	

ANNEXURE - I
TO
SPECIAL CONDITIONS OF CONTRACT

SPECIFICATION
FOR
HEALTH, SAFETY AND
ENVIRONMENT (HSE) MANAGEMENT

Abbreviations:

AERB	:	Atomic Energy Regulatory Board
ANSI	:	American National Standards Institute
BARC	:	Bhabha Atomic Research Centre
BS	:	British Standard
PDIL	:	Projects & development India Limited
ELCB	:	Earth Leakage Circuit Breaker
EPC	:	Engineering, Procurement and Construction
EPCC	:	Engineering, Procurement, Construction and Commissioning
ESI	:	Employee State Insurance
GCC	:	General Conditions of Contract
GM	:	General Manager
GTAW	:	Gas Tungsten Arc Welding
HOD	:	Head of Department
HSE	:	Health, Safety & Environment
HV	:	High Voltage
IS	:	Indian Standard
IE	:	Indian Electricity
JSA	:	Job Safety Analysis
LOTO	:	Lock Out & Tag Out
LPG	:	Liquefied Petroleum Gas
LSTK	:	Lump Sum Turn Key
MV	:	Medium Voltage
PPE	:	Personal Protective Equipment
RCM	:	Resident Construction Manager or Site-in-Charge, as applicable
ROW	:	Right of Way
SCC	:	Special Conditions of Contract
SLI	:	Safe Load Indicator
TBM	:	Tool Box Talks

Construction Standards Committee

Convenor : Sh.

Members : Sh.
Sh.
Sh
Sh.
Sh.
Sh.

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	VI.	Permit for Working at height	HSE-6 Rev.0
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	XVI	Permit for Excavation	HSE-17 Rev 0

**STANDARD SPECIFICATION FOR
HEALTH, SAFETY &
ENVIRONMENT MANAGEMENT
AT CONSTRUCTION SITES**

1.0 SCOPE

This specification establishes the Health, Safety and Environment (HSE) management requirement to be complied by Contractors/Vendors including their sub-contractors/sub vendors during construction.

This specification is not intended to replace the necessary professional judgment needed to design & implement an effective HSE system for construction activities and the contractor is expected to fulfill HSE requirements in this specification as a minimum. It is expected that contractor shall implement best HSE practices beyond whatever are mentioned in this specification.

Requirements stipulated in this specification shall supplement the requirements of HSE Management given in relevant Act(s)/legislations, General Conditions of Contract (GCC), Special Conditions of Contract (SCC) and Job (Technical) Specifications. Where different documents stipulate different requirements, the most stringent shall apply.

2.0 REFERENCES

The document should be read in conjunction with following:

- General Conditions of Contract (GCC)
- Special Conditions of Contract (SCC)
- Building and other construction workers Act,
- Indian Factories Act
- Job (Technical) specifications
- Relevant International / National Codes (refer Appendix-A for standards/codes on HSE)
- Relevant State & National Statutory requirements.
- Operating Manuals Recommendation of Manufacturer of various construction Machineries

3.0 REQUIREMENTS OF HEALTH, SAFETY & ENVIRONMENT (HSE) MANAGEMENT SYSTEM TO BE COMPLIED BY BIDDERS

3.1 Management Responsibility

3.1.1 HSE Policy & Objectives

The Contractor should have a documented HSE policy duly & objectives to demonstrate commitment of their organization to ensure health, safety and environment aspects in their line of operations.

HSE Policy of the contractor shall be made available to Owner / PDIL at the place of execution of specific contract works, as a valid document.

3.1.2 Management System

The HSE management system of the Contractor shall cover the HSE requirements & commitments to fulfill them, including but not limited to what are specified under clause 1.0 and 2.0 above. The Contractor shall obtain the approval of its site specific HSE Plan from PDIL / Owner prior to commencement of any site works. Corporate as well as Site management of the Contractor shall ensure compliance of their HSE Plan at work sites in its entirety & in true spirit.

**STANDARD SPECIFICATION FOR
HEALTH, SAFETY &
ENVIRONMENT MANAGEMENT
AT CONSTRUCTION SITES**

3.1.3 Indemnification

Contractor shall indemnify & hold harmless, Owner/PDIL & their representatives, free from any and all liabilities arising out of non-fulfillment of HSE requirements or its consequences.

3.1.4 Deployment & qualifications of Safety personnel

The Contractor shall designate/deploy various categories of HSE personnel at site as indicated below in sufficient number. In no case, deployment of safety Supervisor / Safety Steward shall substitute deployment of Safety Officer / Safety Engr what is indicated in relevant statute of BOCW Act i.e deployment of safety officer/Safety Engineer is compulsory at project site. The Safety supervisors, Safety stewards etc. would facilitate the HSE tasks at grass root level for construction sites and shall assist Safety Officer / Engineers.

a) Safety Steward

For every 250 workmen, one safety steward shall be deployed.

As a minimum, he shall preferably possess School leaving Certificate (of Class XII with Physics & Chemistry etc.) and trained in fire-fighting as well as in safety/occupational health related subjects, with minimum two year of practical experience in construction work environment and preferably have adequate knowledge of the language spoken by majority of the workers at the construction site.

b) Safety Supervisor

For every 500workmen, one safety Supervisor shall be deployed.

As a minimum, he shall possess a recognized Degree in Science (with Physics & Chemistry) or a diploma in Engg. or Tech. with minimum Two years of practical experience in construction work environment and should possess requisite skills to deal with construction safety & fire related day-to-day issues.

c) Safety Officer / Safety Engineer

One for every 1000 workers or part thereof shall be deployed.

Safety officer/Engineer Should Possess following Qualification & Experience :

- (i) Recognized degree in any branch of Engg. or Tech. or Architecture with practical experience of working in a building or other construction work in supervisory capacity for a period of not less than two years, or possessing recognized diploma in any branch of Engg. or Tech with practical experience of building or other construction work in supervisory capacity for a period of not less than five years.
- (ii) Recognized degree or diploma in Industrial safety with one paper in Construction Safety
- (iii) Preferably have adequate knowledge of the language spoken by majority of the workers at the construction site.

Alternately

- (i) Person possessing Graduation Degree in Science with Physics & Chemistry and degree or diploma in Industrial Safety (from any Indian institutes recognized by

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AICTE or State Council of Tech. Education of any Indian State) with practical experience of working in a building, plant or other construction works (as Safety Officer, in line with Indian Factories Act, 1958) for a period of not less than five years, may be considered as Safety Officer, in case Owner/Client of the project agrees for /approves the same.

d) HSE In-Charge

In case there is more than one Safety Officer at any project construction site, one of them, who is senior most by experience (in HSE discipline), may be designated as HSE In-Charge. Duties & responsibilities of such person shall be commensurate with that of relevant statute and primarily to coordinate with top management of Client and contractors.

In case the statutory requirements i.e. State or Central Acts and / or Rules as applicable like the Building and Other Construction Workers' Regulation of Employment and Conditions of Service- Act,1996 or State Rules (wherever notified), the Factories Act, 1948 or Rules (wherever notified), etc. are more stringent than above clarifications, the same shall be followed.

Contractors shall ensure physical availability of safety personnel at the place of specific work location, where Hot Work Permit is required / granted. No work shall be started at any of the project sites until above safety personnel & concerned Site Engineer of Contractor are physically deployed at site. The Contractor shall submit a HSE organogram clearly indicating the lines of responsibility and reporting system and elaborate the responsibilities of safety personnel in their HSE Plan.

The Contractor shall verify & authenticate credentials of such safety personnel and furnish Bio-Data/ Resume/ Curriculum Vitae of the safety personnel as above for PDIL/Owner's approval, at least 1 month before the mobilization. The Contractor, whenever required, shall arrange submission of original testimonials/certificates of their Safety personnel, to PDIL/Owner (for verification/scrutiny, etc.)

Imposition / Realization of penalty shall not absolve the Contractor from his/her responsibility of deploying competent safety officer at site.

Adequate planning and deployment of safety personnel shall be ensured by the Contractor so that field activities do not get affected because of non-deployment of competent & qualified safety people in appropriate numbers.

3.1.5 Implementation, Inspection/Monitoring

X

The Contractor shall be fully responsible for planning, reporting, implementing and monitoring all HSE requirements and compliance of all laws & statutory requirements.

X

The Contractor shall also ensure that the HSE requirements are clearly understood & implemented conscientiously by their site personnel at all levels at site.

X

The Contractor shall ensure physical presence of their field engineers / supervisors, during the continuation of their contract works / site activities including all material transportation activities. Physical absence of experienced field engineers / supervisors of Contractor at critical work spot during the course of work, may invite severe penalization as per the discretion of EIC, including halting / stoppage of work.

X

Contractor shall furnish their annual Inspection Plan, with regard to project issues /subjects, frequency and performers to PDIL/Owner.

X

The Contractor shall regularly review inspection report internally and implement all practical steps / actions for improving the status continuously.

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- x The Contractor shall ensure important safety checks right from beginning of works at every work site locations and to this effect format No: HSE-10 “Daily Safety Check List” shall be prepared by field engineer & duly checked by safety personnel for conformance.
The Contractor shall carry out inspection to identify various unsafe conditions of work sites/machinery/equipments as well as unsafe acts on the part of workmen/supervisor/engineer while carrying out different project related works.
Adequate records for all inspections shall be maintained by the Contractor and the same shall be furnished to PDIL/Owner, whenever sought.
- x The Contractor shall not carry-out work by engaging single worker anywhere without any supervisor anytime during day or night.
To demonstrate involvement/commitment of site management of Contractor, at least one Safety Walk through in a month shall be carried out by Contractor’s head of site (along with his area manager/field engineers) and a report shall be furnished to PDIL/Owner as per format No: HSE-1” Safety walk through report” followed by compliance for unsatisfactory remarks.
- x As a general practice lifting tools/tackles, machinery, accessories etc. shall be inspected, tested and examined by competent people (approved by concerned State authorities) before being used at site and also at periodical interval (e.g. during replacement, extension, modification, elongation/reduction of machine/parts, etc.) as per relevant statutes. Hydra, cranes, lifting machinery, mobile equipments / machinery / vehicles, etc. shall be inspected regularly by only competent / experienced personnel at site and requisite records for such inspections shall be maintained by every contractor. Contractor shall also maintain records of maintenance of all other site machinery (e.g. generators, rectifiers, compressors, cutters, etc.) & portable tools/equipments being used at project related works (e.g. drills, abrasive wheels, punches, chisels, spanners, etc.). The Contractor shall not make use of arbitrarily fabricated ‘derricks’ at project site for lifting / lowering of construction materials.
- x Site facilities /temporary. installations, e.g. batching plant, cement godown, DG-room, temporary electrical panels/distribution boards, shot-blasting booth, fabrication yards, etc. and site welfare facilities, like labour colonies, canteen/pantry, rest-shelters, motor cycle/bicycle-shed, site washing facilities, First-aid centers, urinals/toilets, etc. should be periodically inspected by Contractor (preferably utilizing HR/Admn. personnel to inspect site welfare facilities) and records to be maintained.

3.1.6 Behaviour Based Safety

- x The contractor shall develop a system to implement Behaviour-Based Safety (BBS) through which work groups can identify, measure and change the behaviours of employees and workers
- x The BBS process shall include the following:
 - Identify the behaviours critical to obtaining required safety performance.
 - Communicate the behaviours and how they are performed correctly to all
 - Observe the work force and record safe/at risk behaviours. Intervene with workers to give positive reinforcement when safe behaviours are observed. Provide coaching/correction when at risk behaviours are observed
 - Collect and record observation data
 - Summarize and analyze observation data
 - Communicate observation data and analysis results to all employees
 - Provide recognition or celebrate when safe behaviour improvements occur
 - Change behaviours to be observed or change activators or change consequences as appropriate.
 - Communicate any changes to workforce
- x Contractor through its own HSE committee shall implement the above process.
The necessary procedures and reporting formats shall be developed by the contractor for approval by PDIL/Owner.

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- x The HSE committee of contractor shall observe individual's behavior for safe practices adapted for utilization/execution of work for following as a minimum:-
 - PPE
 - Tools & equipment
 - Hazard Identification & control
 - House keeping
 - Confined space entry
 - Hot works
 - Excavation
 - Loading & unloading
 - Work At height
 - Stacking & storage
 - Ergonomics
 - Procedures

3.1.7 Awareness and Motivation

- x The Contractor shall promote and develop awareness on Health, Safety and Environment protection among all personnel working for the Contractor.
- x Regular awareness programs and fabrication shop / work site meetings at least on monthly basis shall be arranged on HSE activities to cover hazards/risks involved in various operations during construction.
- x Contractor to motivate & encourage the workmen & supervisory staff by issuing / awarding them with tokens/ gifts/ mementos/ monetary incentives / certificates, etc.
- x Contractor shall assess & recognize the behavioral change of its site engineers / supervisors periodically and constantly motivate / encourage them to implement HSE practices at project works

3.1.8 Fire prevention & First-Aid

- x The Contractor shall arrange suitable First-aid measures such as First Aid Box (Refer Appendix-B for details), trained personnel/nurse (male) to administer First Aid, stand-by Ambulance vehicle and
- x The Contractor shall arrange installation of fire protection measures such as adequate number of steel buckets with sand & water and adequate number of appropriate portable fire extinguishers (Refer Appendix-C for details) to the satisfaction of PDIL/Owner.
- x The Contractor shall deploy trained supervisory personnel / field engineers to cater to any emergency situation.
- x In case the number of workers exceeds 500, the Contractor shall position an Ambulance / vehicle and nurse on round the clock basis very close to the worksite.
- x The Contractor shall arrange FIRE DRILL at each site at least once in three months, involving site workmen and site supervisory personnel & engineers. The Contractor shall maintain adequate record of such fire drills at project site

3.1.9 Documentation

The Contractor shall evolve a comprehensive, planned and documented system covering the following as a minimum for implementation and monitoring of the HSE requirements and the same shall be submitted for approval by owner/PDIL.

- HSE Organogram
- Site specific HSE Plan
- Safety Procedures, forms and Checklist. Indicative list of HSE procedures is attached as Appendix :H
- Inspections and Test Plan
- Risk Assessment & Job Safety Analysis for critical works.

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- x The monitoring for implementation shall be done by regular inspections and compliance of the observations thereof. The Contractor shall get similar HSE requirements implemented at his sub-contractor(s) work site/office. However, compliance of HSE requirements shall be the responsibility of the Contractor. Any review/approval by PDIL/Owner shall not absolve contractor of his responsibility/liability in relation to fulfilling all HSE requirements.

3.1.10 Audit

The Contractor shall submit an Audit Plan to PDIL/Owner indicating the type of audits and covering following as minimum:

- x Internal HSE audits regularly at least on quarterly basis by engaging internal qualified auditors (viz safety officers/Construction personnel having 5 years experience in construction safety and Lead Auditor Course :OSHA 18001certification).
- x External HSE audits regularly at least on every six months by engaging qualified external auditors (viz safety officers/Construction personnel having 10 years experience in construction safety and Lead Auditor Course :OSHA 18001certification).

All HSE shortfalls/ non-conformances on HSE matters brought out during review/audit, shall be resolved forthwith (generally within a week) by Contractor & compliance report shall be submitted to PDIL/Owner.

In addition to above audits by contractor, the contractor's work shall be subjected to HSE audit by PDIL/Owner at any point of time during the pendency of contract. The CONTRACTOR shall take all actions required to comply with the findings of the Audit Report and issue regular Compliance Reports for the same to OWNER/ PDIL till all the findings of the Audit Report are fully complied.

Failure to carry-out HSE Audits & its compliance (internal & external) by Contractor, shall invite penalization.

3.1.11 Meetings

- x The Contractor shall ensure participation of his top most executive at site (viz. Resident Construction Manager / Resident Engineer / Project Manager / Site-in-Charge) in Safety Committee / HSE Committee meetings arranged by PDIL/Owner usually on monthly basis or as and when called for. In case Contractor's top most executive at site is not in a position to attend such meeting, he shall inform PDIL/Owner in writing before the commencement of such meeting indicating reasons of his absence and nominate his representative – failure to do so may invite very stringent penalization against the specific Contractor, as deemed fit in Contract. The obligation of compliance of any observations during the meeting shall be always time bound. The Contractor shall always assist PDIL/Owner to achieve the targets set by them on HSE management during the project implementation.
- x In addition, the Contractor shall also arrange internal HSE meetings chaired by his top most executive at site on weekly basis and maintain records. Such internal HSE meetings shall essentially be attended by field engineers / supervisors (& not by safety personnel only) of the Contractor and its associates. Records of such internal HSE meetings shall be maintained by the Contractor for review by PDIL/Owner or for any HSE Audits.
- x Agenda of internal HSE meeting should broadly cover: -

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- a) Confirmation of record notes / minutes of previous meeting
- b) Discussion on outstanding subjects of previous points / subjects, if any
- c) Incidents / Accidents (of all types) at project site, if any
- d) Current topics related to site activities / subjects of discussion
- e) House keeping
- f) Behavioral Safety
- g) Information / views / deliberations of members / site sub Contractors
- h) Report from Owner / Client
- i) Status of Safety awareness, Induction programs & Training programs

The time frame for such HSE meeting shall be religiously maintained by one and all.

3.1.12 Intoxicating drinks & drugs and Smoking

- x The Contractor shall ensure that his staff members & workers (permanent as well casual) shall not be in a state of intoxication during working hours and shall abide by any law relating to consumption & possession of intoxicating drinks or drugs in force.
- x The Contractor shall not allow any workman to commence any work at any locations of project activity who is/are influenced / effected with the intake of alcohol, drugs or any other intoxicating items being consumed prior to start of work or working day.
- x Awareness about local laws on this issue shall form part of the Induction Training and compulsory work-site discipline.

- x The Contractor shall ensure that all personnel working for him comply with “No-Smoking” requirements of the Owner as notified from time to time. Cigarettes, lighters, auto ignition tools or appliances as well as intoxicating drugs, dry tobacco powder, etc. shall not be allowed inside the project / plant complex.

- x Smoking shall be permitted only inside smoking booths exclusively designated & authorized by the Owner/PDIL.

3.1.13 Penalty

The Contractor shall adhere consistently to all provisions of HSE requirements. In case of non-compliances and also for repeated failure in implementation of any of the HSE provisions, PDIL/Owner may impose stoppage of work without any cost & time implication to the Owner and/or impose a suitable penalty.

The amount of penalty to be levied against defaulted Contractor shall be up to a cumulative limit of

2.0% (Two percent) of the contract value for Item Rate or Composite contracts with an overall cPDILing of 1, 00, 00, 000 (Rupees One crore)

0.5% (Zero decimal five percent) of the contract value for LSTK, OBE, EPC, EPCC or Package contracts with an overall cPDILing of 10, 00.00.000 (Rupees ten crores)

This penalty shall be in addition to all other penalties specified elsewhere in the contract. The decision of imposing stop-work-instruction and imposition of penalty shall rest with PDIL/Owner. The same shall be binding on the Contractor. Imposition of penalty does not make the Contractor eligible to continue the work in unsafe manner.

The amount of penalty applicable for the Contractor on different types of HSE violations is specified below:

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Sl. No.	Violation of HSE norms	Penalty Amount
1.	For not using personal protective equipment (Helmet, Shoes, Goggles, Gloves, Full body harness, Face shield, Boiler suit, etc.)	Rs 500/- per day/ Item / Person.
2.	Working without Work Permit/Clearance	Rs 20000/- per occasion
3.	Execution of work without deployment of requisite field engineer / supervisor at work spot	Rs. 5000/- per violation per day
4.	Unsafe electrical practices (not installing ELCB, using poor joints of cables, using naked wire without top plug into socket, laying wire/cables on the roads, electrical jobs by incompetent person, etc.)	Rs 10000/- per item per day.
5.	Working at height without full body harness, using non-standard/ rejected scaffolding and not arranging fall protection arrangement as required, like hand-rails, life-lines, Safety Nets etc.	Rs. 10000/- per case per day.
6.	Unsafe handling of compressed gas cylinders (No trolley, jubilee clips double gauge regulator, and not keeping cylinders vertical during storage/handling, not using safety cap of cylinder)	Rs 500/- per item per day.
7.	Use of domestic LPG for cutting purpose / not using flash back arresters on both the hoses/tubes on both ends.	Rs. 3000/- per occasion.
8.	No fencing/barricading of excavated areas / trenches.	Rs. 3000/- per occasion.
9.	Not providing shoring/strutting/proper slope and not keeping the excavated earth at least 1.5M away from excavated area.	Rs.5, 000/- per occasion.
10.	Non display of scaffold tags, caution boards, list of hospitals, emergency services available at work locations.	Rs.1000/- per occasion per day
11.	Traffic rules violations like over speeding of vehicles, rash driving, talking on mobile phones during vehicle driving, wrong parking, not using seat belts, vehicles not fitted with reverse horn / warning alarms / flicker lamps during foggy weather.	Rs. 2000/- per occasion per day
12.	Absence of Contractor's RCM/SIC or his nominated representative (prior approval must be taken for each meeting for nomination) from site HSE meetings whenever called by PDIL/Owner & failure to nominate his immediate deputy (in the site-organogram) for such HSE meetings.	Rs10000/- per meeting.
13.	Failure to maintain HSE records by Contractor Safety personnel, in line with approved HSE Plan/Procedures/Contract specifications.	Rs 10000/- per month.
14.	Failure to conduct daily site safety inspection (by Contractor's safety engineers/safety officers), internal HSE meeting, internal HSE Awareness/Motivation Program, Site HSE Training and HSE audit at predefined frequencies (as approved in HSE Plan).	Rs.10000/- per occasion.

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Sl. No.	Violation of HSE norms	Penalty Amount
15.	Failure to submit the monthly HSE report by 5 th of subsequent month to Project's Engineer-in-Charge / Owner	Rs. 10000/- per occasion and Rs. 1000/- per day of further delay.
16.	Poor House Keeping	Rs. 5000/- per occasion per subject
17.	Failure to report & follow up accident (including Near Miss) reporting system within specific time-frame.	Rs. 20000/- per occasion
18.	Degradation of environment (not confining toxic spills, spilling oil/lubricants onto ground)	Rs10000/- per occasion
19.	Not medically examining the workers before allowing them to work at height / to work in confined space / to work in shot-blasting / to work for painting / to work in bitumen or asphalt works, not providing ear muffs while allowing them to work in noise polluted areas, made them to work in air polluted areas without respiratory protective devices, etc.	Rs 5000/- per occasion per worker
20.	Violation of any other safety condition as per job HSE plan / work permit and HSE conditions of contract (e.g. using crowbar on cable trenches, improper welding booth, not keeping fire extinguisher ready at hot work site, unsafe rigging practices, non-availability of First-Aid box at site, not using hood with respiratory devices by blaster for shot//grit blasting, etc.)	Rs. 5000/- per occasion
21.	Failure to carry-out Safety audit in time (internal & external), close-out of identified shortfalls of Observations of Safety Aspects(OSA),etc.	Rs. 20,000/- per occasion
22.	Carrying out sand blasting instead of grit/shot blasting	Rs. 50,000/- per day
23.	Failure to deploy adequately qualified and competent Safety Officer	Rs. 10000/- per day per Officer
24.	Utilization of hydra/ back-hoe loader for material shifting or any other unauthorized /unsafe lifting works	Rs 25,000/- per occasion
25.	Any incident / accident at project site has been caused because of willful negligence or gross violation of safety measures / provisions on the part of the Contractor or any of its sub-agencies	Rs 10,00,000/-per occasion
26.	Any violation not covered above	To be decided by PDIL/Owner.

X

The Contractor shall make his field engineers/supervisors fully aware of the fact that they keep track with the site workmen for their behavior and compliance of various HSE requirements. Safety lapses / defects of project construction site shall be attributable to the concerned job supervisor / engineer of the Contractor, (who remains directly responsible for safely executing field works). For repeated HSE violations, concerned job supervisor / engineer shall be reprimanded or appropriate action, as deemed fit, shall be initiated (with an information to PDIL & Owner) by the concerned Contractor.

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Contractor shall initiate verbal warning shall be given to the worker/employee during his first HSE violation. A written warning shall be issued on second violation and specific training shall be arranged / provided by the Contractor to enhance HSE awareness/skill including feedback on the mistakes/ flaws. Any further violation of HSE stipulations by the erring individuals shall call for his forthright debar from the specific construction site. A record of warnings for each worker/employee shall be maintained by the Contractor, like by punching their cards / Gate passes or by displaying their names at the Project entry gate. Warnings, penalizations, appreciations etc. shall be discussed in HSE Committee meetings by site Head of the Contractor.

3.1.14 Accident/ Incident investigation

All accidents / incidents shall be informed to PDIL/Owner at least telephonically by Contractor immediately and in writing within 24 hours on Format No. HSE-2 as applicable , by Contractor. Thereafter, a Supplementary Accident / Incident investigation Report on Format No. HSE-3 shall be submitted to PDIL/Owner within 72 hours. Near Miss incident(s), Dangerous accidents/incident shall also be reported on Format No. HSE-4 within 24 hours. The accident/ incident shall be investigated by a team of Contractor's senior Site personnel (involving Site-in-Charge or at least by his deputy) for establishing root-cause and recommending corrective & preventive actions. Findings shall be documented and suitable actions taken to avoid recurrences shall be communicated to PDIL/Owner. Owner/PDIL shall have the liberty to independently investigate such occurrences and the Contractor shall extend all necessary help and cooperation in this regard. PDIL/Owner shall have the right to share the content of this report with the outside world.

3.2 House Keeping

The Contractor shall ensure that a high degree of house keeping is maintained and shall ensure inter alia; the followings:

- a) All surplus earth and debris are removed/disposed off from the working areas to designated location(s).
- b) Unused/surplus cables, steel items and steel scrap lying scattered at different places within the working areas are removed to identify location(s).
- c) All wooden scrap, empty wooden cable drums and other combustible packing materials, shall be removed from work place to identified location(s).
- d) Roads shall be kept clear and materials like pipes, steel, sand, boulders, concrete, chips and bricks etc shall not be allowed on the roads to obstruct free movement of men & machineries.
- e) Fabricated steel structural, pipes & piping materials shall be stacked properly for erection.
- f) Water logging on roads shall not be allowed.
- g) No parking of trucks/trolleys, cranes and trailers etc shall be allowed on roads, which may obstruct the traffic movement.
- h) Utmost care shall be taken to ensure over all cleanliness and proper upkeep of the working areas.
- i) Trucks carrying sand, earth and pulverized materials etc. shall be covered while moving within the plant area/ or these materials shall be transported with top surface wet.
- j) The contractor shall ensure that the atmosphere in plant area and on roads is free from particulate matter like dust, sand, etc. by keeping the top surface wet for ease in breathing.
- k) At least two exits for any unit area shall be assured at all times – same arrangement is preferable for digging pits / trench excavation / elevated work platforms / confined spaces etc.
- l) Welding cables and the power cable must be segregated and properly stored and used .The same shall be laid away from the area of movement and shall be free from obstruction.
- m) Schedule for upkeep/cleaning of site to be firmed up and implemented on regular basis

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The Contractor shall carry-out regular checks (minimum one per fortnight) as per format No: HSE-11 for maintaining high standard of housekeeping and maintain records for the same.

3.3 HSE Measures

3.3.1 Construction Hazards

The Contractor shall ensure identification of all Occupational Health, Safety & Environmental hazards in the type of work he is going to undertake and enlist mitigation measures. Contractor shall carry out Job Safety Analysis (JSA)/Risk Analysis specifically for high risk jobs/critical jobs like

- a) Working at height (+2.0 Mts height) for cold (incl. colour washing, painting, insulation etc.) & hot works.
- b) Work in confined space,
- c) Deep excavations & trench cutting (depth > 2.0 mts.)
- d) Operation & Maintenance of Batching Plant.
- e) Shuttering / concreting (in single or multiple pour) for columns, parapets & roofs.
- f) Erection & maintenance of Tower Crane.
- g) Erection of structural steel members / roof-trusses / pipes at height more than 2.0 Mts. with or without crane.
- h) Erection of pipes (full length or fabricated) at height more than 2.0 Mts. height with Crane of 100T capacity.
- i) All lifts using 100T Crane plus mechanical pulling.
- j) All lifts using two cranes in unison (Tandem Lifting).
- k) Any lift exceeding 80% capacity of the lifting equipments (hydra, crane etc.).
- l) Laying of pipes (isolated or fabricated) in deep narrow trenches – manually or mechanically.
- m) Maintenance of crane / extension or reduction of crane-boom on roads or in yards.
- n) Erection of any item at >2.0 Mts. height using 100T crane or of higher capacity
- o) Hydrostatic test of pipes, vessels & columns and water-flushing.
- p) Radiography jobs (in-plant & open field)
- q) Work in Live Electrical installations / circuits
- r) Handling of explosives & Blasting operations
- s) Demolishing / dismantling activities
- t) Welding / gas cutting jobs at height (+2.0 Mts.)
- u) Lifting / placing roof-girders at height (+2.0 Mts.)
- v) Lifting & laying of metallic / non-metallic sheet over roof/structures.
- w) Lifting of pipes, gratings, equipments/vessels at heights (+2.0 Mts) with & without using cranes
- x) Calibration of equipment, instruments and functional tests at yards / work-sites.
- y) Operability test of Pump, Motors (after coupling) & Compressors.
- z) Cold or Hot works inside Confined Space.
- aa) Transportation & shifting of ODC consignments into project areas.
- bb) Working in “charged/Live” elect. Panels
- cc) Stress Relieving works (Electrically or by Gas-burners).
- dd) Pneumatic Tests
- ee) Card board blasting
- ff) Chemical cleaning

and take feedback from PDIL/Owner. The necessary HSE measures devised shall be put in to place, prior to start of an activity & also shall be maintained during the course of works, by the Contractor. Copies of such JSAs shall be kept available at work sites by the Contractor to enable all concerned carrying out checks / verification.

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A list of typical construction hazards along with their effects & preventive measures is given in **Appendix-E**.

3.3.2 Accessibility

X

The Contractor shall provide safe means of access (in sufficient numbers) & efficient exit to any working place including provisions of suitable and sufficient scaffolding at various stages during all operations of the work for the safety of his workmen and PDIL/Owner.

X

The Contractor shall implement use of all measures including use of “life line”, “fall-arresters”, “retractable fall arresters”, “safety nets” etc. during the course of using all safe accesses & exits, so that in no case any individual remains at risk of slip & fall during their travel.

X

The access to operating plant / project complex shall be strictly regulated. Any person or vehicle entering such complex shall undergo identification check, as per the procedures in force / requirement of PDIL/Owner.

X

Accessibility to ‘confined space’ shall be governed by specific system / regulation, as established at project site.

3.3.3 Personal Protective Equipments (PPEs)

X

The Contractor shall ensure that all their staff, workers and visitors including their sub-contractor(s) have been issued (records to be kept) & wear appropriate PPEs like nape strap type safety helmets preferably with head & sweat band with ¾” cotton chin strap (made of industrial HDPE), safety shoes with steel toe cap and antiskid sole, full body harness (C⁰ marked and conforming to EN361), protective goggles, gloves, ear muffs, respiratory protective devices, etc. All these gadgets shall conform to applicable IS Specifications/CE or other applicable international standards. The Contractor shall implement a regular regime of inspecting physical conditions of the PPEs being issued / used by the workmen of their own & also its sub-agencies and the damaged / unserviceable PPEs shall be replaced forthwith.

X

Owner/PDIL may issue a comprehensive color scheme for helmets to be used by various agencies. The Contractor shall follow the scheme issued by the owner/PDIL and shall choose any colour other than white (for Owner) or blue (for PDIL). All HSE personnel shall preferably wear dark green band on their helmet so that workmen can approach them for guidance during emergencies. HSE personnel shall preferably wear such dresses with fluorescent stripes, which are noticeable during night, when light falls on them.

X

For shot blasting, the usage of protective face shield and helmets, gauntlet and protective clothing is mandatory. Such protective clothing should conform relevant IS Specification.

X

For off-shore jobs/contracts, contractor shall provide PPEs (new) of all types to PDIL & Owner's personnel, at his (contractor's) cost. All personnel shall wear life jacket at all time.

X

An indicative list of HSE standards/codes is given under **Appendix-A**.

X

Contractor shall ensure procurement & usage of following safety equipments/ accessories (conforming to applicable IS mark / CE standard) by their staff, workmen & visitors including their subcontractors all through the span of project construction / pre-commissioning/ Commissioning:-‘

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- a. PPEs (Helmet, Spectacle, Ear-muff, Face shield, Hand gloves, Safety Shoes, Gum boot)
- b. Barricading tape / warning signs
- c. Rechargeable Safety torch (flame-proof)
- d. Safety nets (with tie-chords)
- e. Fall arresters
- f. Portable ladders (varying lengths)
- g. Life-lines (steel wire-rope, dia not less than 8.0 mm)
- h. Full body harness (double lanyard)
- i. Lanyard
- j. Karabiner
- k. Retractable fall arresters (various length)
- l. Portable fire extinguishers (DCP type) – 5 kg capacity
- m. Portable Multi Gas detector
- n. Sound level meter
- o. Digital Lux meter
- p. Fire hoses & flow nozzles
- q. Fire blankets / Fire retardant cloth (with eyelets)

3.3.4 Working at height

x

The Contractor shall issue permit for working (PFW) at height after verifying and certifying the checkpoints as specified in the attached permit (Format No. HSE-6). He shall also undertake to ensure compliance to the conditions of the permit during the currency of the permit including adherence of personal protective equipments. Contractor's Safety Officer shall verify compliance status of the items of permit document after implementation of action is completed by Contractor's execution / field engineers at work site. Job Safety Analysis (JSA) for specific works at height duly commented by PDIL/Owner, shall be kept attached with particular Permit for Work (PFW) at site for ready reference & follow-up.

x

Such PFW shall be initially issued for one single shift or expected duration of normal work and extended further for balance duration, if required. PDIL/Owner can devise block-permit system at any specific area, in consultation with project specific HSE Committee to specify the time-period of validity of such PFW or its renewal. This permit shall be applicable in areas where specific clearance from Owner's operation Deptt. /Safety Deptt. is not required. PDIL / Owner's field Engineers/Safety Officers/Area Coordinators may verify and counter sign this permit (as an evidence of verification) during the execution of the job.

x

All personnel shall be medically examined & certified by registered doctor, confirming their 'medical fitness for working at height. The fitness examination shall be done once in six months.

x

In case work is undertaken without taking sufficient precautions as given in the permit, PDIL /Owner Engineers may exercise their authority to cancel such permit and stop the work till satisfactory compliance/rectification is arranged made. Contractors are expected to maintain a register for issuance of permit and extensions thereof including preserving the used permits for verification during audits etc.

x

The Contractor shall arrange (at his cost) and ensure use of Fall Arrester Systems by his workers. Fall arresters are to be used while climbing/descending tall structures or vessels / columns etc. These arresters should lock automatically against the anchorage line, restricting free fall of the user. The device is to be provided with a double security opening system to ensure safe attachment or release of the user at any point of rope. In order to

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avoid shock, the system should be capable of keeping the person in vertical position in case of a fall.

X

The Contractor shall ensure that Full body harnesses conforming EN361 and having authorized C⁰ marking is used by all personnel while working at height. The lanyards and life lines should have enough tensile strength to take the load of the worker in case of a fall. One end of the lanyard shall be firmly tied with the harnesses and the other end with life line. The harness should be capable of keeping the workman vertical in case of a fall, enabling him to rescue himself.

X

The Contractor shall provide Roof Top Walk Ladders for carrying out activities on sloping roofs in order to reduce the chances of slippages and falls.

X

The Contractor shall ensure that a proper Safety Net System is used wherever the hazard of fall from height is present. The safety net, preferably a knotted one with mesh ropes conforming to IS 5175/ ISO 1140 shall have a border rope & tie cord of minimum 12mm dia. The Safety Net shall be located not more than 6.0 meters below the working surface extending on either side up to sufficient margin to arrest fall of persons working at different heights.

X

In case of accidental fall of person on such Safety Net, the bottom most portion of Safety Net should not touch any structure, object or ground.

X

The Contractor shall ensure positive isolation while working at different levels like in the pipe rack areas. The working platforms with toe boards & hand rails shall be sufficiently strong & shall have sufficient space to hold the workmen and tools & tackles including the equipments required for executing the job. Such working platforms shall have mid-rails, to enable people work safely in sitting posture.

3.3.5 Scaffoldings & Barricading

X

Suitable scaffoldings shall be provided to workmen for all works that cannot be safely done from the ground or from solid construction except such short period work that can be safely done using ladders or certified (by 3rd party competent person) man-basket. When a ladder is used, an extra workman shall always be engaged for holding the ladder.

X

The Contractor shall ensure that the scaffolds used during construction activities shall be strong enough to take the designed load. Main Contractor shall always furnish duly approved construction-design details of scaffold & SWL (from competent designers) free of charge, before they are being installed / constructed at site. Owner/PDIL reserves the right to ask the Contractor to submit certification and or design calculations from his Head office / Design/ Engineering expert regarding load carrying capacity of the scaffoldings.

X

All scaffolds shall be inspected by a competent Scaffolding Inspector of the Contractor. He shall paste a GREEN tag (duly signed by competent Scaffolding Inspector) on each scaffold found safe and a RED tag (duly signed by competent Scaffolding Inspector) on each scaffold found unsafe. Scaffolds with GREEN tag only shall be permitted to be used and Scaffolds with RED ones shall immediately be made inaccessible. Work being found continuing on scaffolds with RED tag shall be considered unauthorized work by Contractor and may invite penalization from PDIL/Owner. For every 120-125 m²/m³ area / volume or its parts thereof minimum one TAG shall be provided.

X

The Contractor shall ensure positive barricading (indicative as well as protective) of the excavated, radiography, heavy lift, high pressure hydrostatic & pneumatic testing and other such areas. Sufficient warning signs shall be displayed along the barricading areas.

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X

Scaffolding shall be constructed using foot seals or base plates only.

3.3.6 Electrical installations

X

All electrical installations/ connections shall be carried out as per the provisions of latest revision of following codes/standards, in addition to the requirements of Statutory Authorities and IE/applicable international rules & regulations:

- OISD STD 173 : Fire prevention & protection system for electrical installations
- SP 30 (BIS) : National Electric Code

X

All electrical installations shall be approved by the concerned statutory authorities.

X

All temporary electrical installations / facilities shall be regularly checked by the licensed/competent electricians of the Contractor and appropriate records shall be maintained in format no: HSE-12" Inspection of temporary electrical booth/installation at project construction site". Such inspection records are to be made available to PDIL/Owner, whenever asked for.

3.3.6.1 The Contractor shall meet the following requirements:

- a. Shall make Single Line Diagram (SLD) for providing connection to each equipments & machinery and the same (duly approved by PDIL/Owner) shall be pasted on the front face of DBs (distribution boards) or JBs (Junction boxes) at every site. (A typical Switch Board Sketch is attached as Appendix -G)
- b. Ensure that electrical systems and equipment including tools & tackles used during construction phase are properly selected, installed, used and maintained as per provisions of the latest revision of the Indian Electrical/ applicable international regulations.
- c. Shall deploy qualified & licensed electricians for proper & safe installation and for regular inspection of construction power distribution system/points including their earthing. A copy of the license shall be submitted to PDIL / Owner for records. Availability of at least one competent (ITI qualified) / licensed electrician (by State Elec. authorities) shall be ensured at site round the clock to attend to the normal/emergency jobs.
- d. All switchboards / welding machines shall be kept in well-ventilated & covered shed/ with rain shed protection. The shed shall be elevated from the existing ground level to avoid water logging inside the shed . Installation of electrical switch board must be done taking care of the prevention of shock and safety of machine.
- e. No flammable materials shall be used for constructing the shed. Also flammable materials shall not be stored in and around electrical equipment / switchboard. Adequate clearances and operational space shall be provided around the equipment.
- f. Fire extinguishers and insulating mats shall be provided in all power distribution centers.
- g. Temporary electrical equipment shall not be employed in hazardous area without obtaining safety permit.
- h. Proper housekeeping shall be done around the electrical installations.
- i. All temporary installations shall be tested before energizing, to ensure proper earthing, bonding, suitability of protection system, adequacy of feeders/cables etc.

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- j. All welders shall use hand gloves irrespective of holder voltage.
 - k. Multilingual (Hindi, English and local language) caution boards, shock treatment charts and instruction plate containing location of isolation point for incoming supply, name & telephone No. of contact person in emergency shall be provided in substations and near all distribution boards / local panels.
 - l. Operation of earth leakage device shall be checked regularly by temporarily connecting series test lamp (2 bulbs of equal rating connected in series) between phase and earth. ELCB tester /test meter shall be used for testing ELCBs
 - m. Regular inspection of all installations at least once in a month. (Ref. **Format HSE-12**).
- 3.3.6.2 The following features shall also be ensured for all electrical installations during construction phase by the contractor:
- x Each installation shall have a main switch with a protective device, installed in an enclosure adjacent to the metering point. The operating height of the main switch shall not exceed 1.5 M. The main switch shall be connected to the point of supply by means of armoured cable.
 - x The outgoing feeders shall be double or triple pole switches with fuses / MCBs. Loads in a three phase circuit shall be balanced as far as possible and load on neutral should not exceed 20% of load in the phase.
 - x The installation shall be adequately protected against overload, short circuit and earth leakage by the use of suitable protective devices. Fuses wherever used shall be HRC type. Use of rewirable fuses shall be strictly prohibited. The earth leakage device shall have an operating current not exceeding 30 mA.
 - x All connections to the hand tools / welding receptacles shall be taken through proper switches, sockets and plugs.
 - x All single phase sockets shall be minimum 3 pin type only. All unused sockets shall be provided with socket caps.
 - x Only 3 core (P+N+E) overall sheathed flexible cables with minimum conductor size of 1.5 mm copper shall be used for all single phase hand tools.
 - x Only metallic distribution boxes with double earthing shall be used at site. No wooden boxes shall be used.
 - x All power cables shall be terminated with compression type cable glands. Tinned copper lugs shall be used for multi-strand wires / cables.
 - x Cables shall be free from any insulation damage.
 - x Minimum depth of cable trench shall be 750 mm for MV & control cables and 900 mm for HV cables. These cables shall be laid over a sand layer and covered with sand, brick & soil for ensuring mechanical protection. Cables shall not be laid in waterlogged area as far as practicable. Cable route markers shall be provided at every 25 M of buried trench route. When laid above ground, cables shall be properly cleated or supported on rigid poles of at least 2.1 M high. Minimum head clearance of 6 meters shall be provided at road crossings.

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- X Under ground road crossings for cables shall be avoided to the extent feasible. In any case no under ground power cable shall be allowed to cross the roads without pipe sleeve.
 - X All cable joints shall be done with proper jointing kit. No taped/ temporary joints shall be used.
 - X An independent earthing facility should preferably be established within the temporary installation premises. All appliances and equipment shall be adequately earthed. In case of armoured cables, the armour shall be bonded to the earthing system.
 - X All cables and wire rope used for earth connections shall be terminated through tinned copper lugs.
 - X In case of local earthing, earth electrodes shall be buried near the supply point and earth continuity wire shall be connected to local earth plate for further distribution to various appliances. All insulated wires for earth connection shall have insulation of green colour.
 - X Separate core shall be provided for neutral. Earth / Structures shall not be used as a neutral in any case.
 - X ON/OFF position of all switches shall be clearly designated / painted for easy isolation in emergency.
- 3.3.7 Welding/ Gas cutting**
- X Contractor shall ensure that flash back arrestors conforming to BS: 6158 or equivalent are installed on all gas cylinders as well as at the torch end of the gas hose, while in use.
 - X All cylinders shall be mounted on trolleys and provided with a closing key. Empty & filled-up gas cylinders shall be stored separately with TAG, protecting them from direct sun or rain. Minimum 2 nos. of Portable DCP type fire extinguishers (10 kg) shall be maintained at the gas cylinder stores. Stacking & storing of compressed gas cylinders shall be arranged away from DG set, hot works, Elect. Panels / Elec. boards, etc
 - X The burner and the hose placed downstream of pressure reducer shall be equipped with Flash Back Arrester/Non Return Valve device.
 - X The hoses for acetylene and oxygen cylinders must be of different colours. Their connections to cylinders and burners shall be made with a safety collar.
 - X At end of work, the cylinders in use shall be closed and hoses depressurized.
 - X Cutting of metals using gases, other than oxygen & acetylene, shall require written concurrence from Owner.
 - X All welding machines shall have effective earthing at least at distinctly isolated two points. In order to help maintain good housekeeping, and to reduce fire hazard, live electrode bits shall be contained safely and shall not be thrown directly on the ground.
 - X The hoses of Acetylene and Oxygen shall be kept free from entanglement & away from common pathways / walkways and preferably be hanged overhead in such a manner which can avoid contact with cranes, hydra or other mobile construction machinery.
 - X Hot spatters shall be contained / restricted appropriately (by making use of effective fire-retardant cloth/fabric) and their flying-off as well as chance of contact with near-by flammable materials shall be stopped.
 - X The Contractor shall arrange adequate systems & practices for accumulation / collection of metal & other scraps and remnant electrodes and their safe disposal at regular interval so as to maintain the fabrication and other areas satisfactorily clean & tidy.
 - X All gas cylinders must have a cylinder cap on at all times when not in use.

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3.3.8 Ergonomics and tools & tackles

X

The Contractor shall assign to his workmen, tasks commensurate with their qualification, experience and state of health.

X

All lifting tools, tackles, equipment, accessories including cranes shall be tested periodically by statutory/competent authority for their condition and load carrying capacity. Valid test & fitness certificates from the applicable authority shall be submitted to Owner/PDIL for their review/acceptance before the lifting tools, tackles, equipment, accessories and cranes are used.

X

The contractor shall not be allowed to use defective equipment or tools not adhering to safety norms.

X

Contractor shall arrange non-sparking tools for project construction works in operating plant areas / hydrocarbon prone areas.

X

Wherever required the Contractor shall make use of Elevated Work Platforms (EWP) or Aerial Work Platforms (mobile or stationary) to avoid ergonomical risks and workmen shall be debarred to board such elevated platform during the course of their shifting / transportation.

X

Contractor shall ensure installation of Safe Load Indicator (SLI) on all cranes (while in use) to minimize overloading risk. SLI shall have capability to continuously monitor and display the load on the hook, and automatically compare it with the rated crane capacity at the operating condition of the crane. The system shall also provide visual and audible warnings at set capacity levels to alert the operator in case of violations.

X

The contractor shall be responsible for safe operations of different equipments mobilized and used by him at the workplace like transport vehicles, engines, cranes, mobile ladders, scaffoldings, work tools, etc.

X

The Contractor shall arrange periodical training for the operators of hydra, crane, excavator, mobile machinery, etc. at site by utilizing services from renowned manufacturers

3.3.9 Occupational Health

X

The contractor shall identify all operations that can adversely affect the health of its workers and issue & implement mitigation measures.

X

For surface cleaning operations, sand blasting shall not be permitted even if not explicitly stated elsewhere in the contract.

X

To eliminate radiation hazard, Tungsten electrodes used for Gas Tungsten Arc Welding shall not contain Thorium.

X

Appropriate respiratory protective devices(hood with respiratory devices) shall be used to protect workmen from inhalation of air borne contaminants like silica, asbestos, gases, fumes, etc.

X

Workmen shall be made aware of correct methods for lifting, carrying, pushing & pulling of heavy loads. Wherever possible, manual handling shall be replaced by mechanical lifting equipments.

X

For jobs like drilling/demolishing/dismantling where noise pollution exceeds the specified limit of 85 decibels, ear muffs shall be provided to the workers.

X

To avoid work related upper limb disorders (WRULD) and backaches, Display Screen Equipments' workplace stations shall be carefully designed & used with proper sitting postures. Power driven hand-held tools shall be maintained in good working condition to

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minimize their vibrating effects and personnel using these tools shall be taught how to operate them safely & how to maintain good blood circulation in hands.

x

The Contractor shall arrange health check up (by registered medical practitioner) for all the workers at the time of induction. Health check may have to be repeated if the nature of duty assigned to him is changed necessitating health check or doubt arises about his wellness. PDIL/Owner reserves the right to ask the contractor to submit medical test reports. Regular health check-ups are mandatory for the workers assigned with Welding, Radiography, Blasting, Painting, Heavy Lift and Height (>2m) jobs. All the health check-ups shall be conducted by registered Medical practitioner and records are to be maintained by the Contractor.

x

The Contractor shall ensure vaccination of all the workers including their families, during the course of entire project span.

3.3.10 Hazardous substances

x

Hazardous, inflammable and/or toxic materials such as solvent coating, thinners, anti-termite solutions, water proofing materials shall be stored in appropriate containers preferably with lids having spillage catchment trays and shall be stored in a good ventilated area. These containers shall be labeled with the name of the materials highlighting the hazards associated with its use and necessary precautions to be taken. Respective MSDS (Material Safety Data Sheet) shall be made available at site & may be referred whenever problem arises.

x

Where contact or exposure of hazardous materials are likely to exceed the specified limit or otherwise have harmful effects, appropriate personal protective equipments such as gloves, goggles/face-shields, aprons, chemical resistant clothing, respirator, etc. shall be used.

x

The work place shall be checked prior to start of activities to identify the location, type and condition of any asbestos materials which could be disturbed during the work. In case asbestos material is detected, usage of appropriate PPEs by all personnel shall be ensured and the matter shall be reported immediately to PDIL/ Owner.

3.3.11 Slips, trips & falls

The contractor shall establish a regular cleaning and basic housekeeping programme that covers all aspects of the workplace to help minimize the risk of slips, trips & falls. The contractor shall take positive measures like keeping the work area tidy, storing waste in suitable containers & harmful items separately, keeping passages, stairways, entrances & exits especially emergency ones clear, cleaning up spillages immediately and replacing damaged carpet/ floor tiles, mats & rugs at once to avoid slips, trips & falls.

3.3.12 Radiation exposure

x

All personnel exposed to physical agents such as ionizing & non-ionizing radiation, including ultraviolet rays or similar other physical agents shall be provided with adequate shielding or protection commensurate with the type of exposure involved.

x

For Open Field Radiography works , requirements of Bhabha Atomic Research Centre (BARC)/ Atomic Energy Regulatory Board (AERB) shall be followed.

x

The Contractor shall implement an effective system of control (as described in the AERB regulations) at site for handling radiography-sources & for avoiding its misuse & theft.

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X

The contractor shall generate the Format No: HSE-8 “Permit for radiation work” before start of work.

X

In case the radiography work has to be carried out at day time, suitable methodology to be used so that other works, people are not affected.

3.3.13 Explosives/Blasting operations

X

Blasting operations shall be carried out as per latest Explosive Rules (Indian / International) with prior permission. The Contractor shall obtain license from Chief Controller of Explosives (CCoE) for collection, transportation, storage of explosives as well as for carrying out blasting operations.

X

The Contractor shall prepare exclusive method statement (in cognizance with statutory requirements) for diffusing unfired explosives, if any, at project site before carrying out actual task. Nowhere blasting shall be carried out by the Contractor or its agency without the involvement of competent supervisor and licensed blaster / shot blaster.

3.3.14 Demolition/ Dismantling

X

The contractor shall adhere to safe demolishing/ dismantling practices at all stages of work to guard against unsafe working practices.

X

The contractor shall disconnect service lines (power, gas supply, water, etc.)/ make alternate arrangements prior to start of work and restore them, if required as directed by PDIL/ Owner at no extra cost.

X

Before carrying out any demolition/ dismantling work, the contractor shall take prior approval of PDIL/Owner and generate the Format No.HSE-9. For revamp jobs in operating plants where location of underground utilities is not known with certainty, the contractor shall depute an experienced engineer for supervision and shall make adequate arrangements for Fire fighting & First-Aid during the execution of these activities.

X

The Contractor shall arrange approved Job Safety Analysis (JSA) / Method Statement for the specific demolition / dismantling task and corresponding action plan commensurate with hazards / risks associated therein. In no case any activity related to demolition / dismantling shall be carried out by the Contractor without engaging own supervision / field engineer.

3.3.15 Road Safety

X

X The Contractor shall ensure adequately planned road transport safety management system.

The vehicles shall be fitted with reverse warning alarms & flashing lights / fog-lights and usage of seat belts shall be ensured.

X

The Contractor shall also ensure a separate pedestrian route for safety of the workers and comply with all traffic rules & regulations, including maintaining speed limit of 20 kmph or indicated by owner for all types of vehicles / mobile machinery. The maximum allowable speed shall be adhered to.

X

In case of an alert or emergency, the Contractor must arrange clearance of all the routes, roads, access. The Contractor shall deploy sufficient number of traffic controllers at project site routes / roads/ accesses, to alert reversing movement of vehicles & machinery as well as pedestrians.

X

Dumpers, Tippers, etc. shall not be allowed to carry workers within the plant area and also to & from the labour colony to & from project sites.

X

Hydras shall only be allowed for handling the materials at fabrication/ storage yards and in no case shall be allowed to transport the materials over project / plant roads.

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- X The Contractor shall not deploy any such mobile machinery / equipments, which do not have competent operator and / or experienced banks-man / signal-man. Such machinery / equipments shall have effective limit-switches, reverse-alarm, front & rear-end lights etc. and shall be maintained in good working order.
- X The Contractor shall not carry-out maintenance of vehicles / mobile machinery occupying space on project / plant roads and shall always arrange close supervision for such works.
- X For pipeline jobs, the contractor shall submit a comprehensive plan covering transportation, loading / unloading of pipes, movement of side booms, movement of vehicles on the ROW, etc.
- X Contractor's shall arrange /install visible road signs, diversion boards, caution boards, etc on project roads for safe movement of men and machinery.

3.3.16 Welfare measures

Contractor shall, at the minimum, ensure the following facilities at work sites:

- X A crèche at site where 10 or more female workers are having children below the age of 6 years.
- X Adequately ventilated / illuminated rooms at labour camps & its hygienic up-keeping. Reasonable canteen facilities at site and in labour camps at appropriate location depending upon site conditions. Contractor shall make use of "industrial" variety of LPG cylinder & satisfactory illumination at the canteens. Necessary arrangement for efficient disposal of wastes from canteens & urinals /toilets shall also be made and regular review shall be made to maintain the ambience satisfactorily hygienic & shall also comply with all applicable statutory requirements.
- X Adequately lighted & ventilated Rest rooms at site (separate for male workers and female workers).
- X Urinals, Toilets, drinking water, washing facilities, adequate lighting at site and labour camps, commensurate with applicable Laws / Legislation.

3.3.17 Environment Protection

Contractor shall ensure proper storage and utilization methodology of materials that are detrimental to the environment. Where required, Contractor shall ensure that only the environment friendly materials are selected and emphasize on recycling of waste materials, such as metals, plastics, glass, paper, oil & solvents. The waste that cannot be minimized, reused or recovered shall be stored and disposed of safely. In no way, toxic spills shall be allowed to percolate into the ground. The contractor shall not use the empty areas for dumping the wastes.

The contractor shall strive to conserve energy and water wherever feasible.

The contractor shall ensure dust free environment at workplace by sprinkling water on the ground at frequent intervals. The air quality parameters for dust, poisonous gases, toxic releases, harmful radiations, etc. shall be checked by the contractor on daily basis and whenever need arises.

The contractor shall not be allowed to discharge chemicals, oil, silt, sewage, sullage and other waste materials directly into the controlled waters like surface drains, streams, rivers, ponds. A discharge plan suggesting the methods of treating the waste before discharging shall be submitted to PDIL/Owner for approval.

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For pipeline jobs, top soil shall be stacked separately while making ROW through fields. This fertile soil shall be placed back on top after backfilling.

For offshore construction barges, arrangements shall be made for safe disposal of human, food & other wastes and applicable laws in this regard shall be followed.

3.3.18 Rules & Regulations

All persons deployed at site shall be knowledgeable of and comply with the environmental laws, rules & regulations relating to the hazardous materials, substances and wastes. Contractor shall not dump, release or otherwise discharge or dispose off any such materials without the express authorization of PDIL/Owner. An indicative list of Statutory Acts & Rules relating to HSE is given under Appendix-D.

3.3.19 Weather Protection

Contractor shall take appropriate measures to protect workers from severe storms, rain, solar radiations, poisonous gases, dust, etc. by ensuring proper usage of PPEs like Sun glasses, Sun screen lotions, respirators, dust masks, etc. and rearranging/ planning the construction activities to suit the weather conditions. Effective arrangement (without creating inconvenience to project facilities & permanent installations) for protecting workmen from hailstorm, drizzle in the form of temporary shelter shall be made at site.

3.3.20 Communication

All persons deployed at the work site shall have access to effective means of communication so that any untoward incident can be reported immediately and assistance sought by them.

All health & safety information shall be communicated in a simple & clear language easily understood by the local workforce.

For information to all, typical subjects that should be communicated are: -

Inside the company (Top to down)

- a. Quality Policy
- b. HSE Policy contents
- c. Environment Policy
- d. HSE Objectives
- e. Safety Cardinal Rules
- f. HSE Target – reached or missed
- g. Praises & Warnings to personnel for HSE Management
- h. Safety Walk Through Reports and safety defects / shortfalls (by management)
- i. HSE Audit results
- j. Revised Statutory Health & Safety provisions, if any
- k. H & S publicity
- l. Suggestions

Inside the Company (Bottom to up)

- a. Complaints
- b. Compliances on safety defects / shortfalls
- c. Suggestions
- d. Proposals for changes & improvements
- e. HSE Reports (including near-miss reports)

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3.3.21 Confined Space Entry

The contractor shall generate a work permit (Format No. HSE -7) before entering a confined space. People, who are permitted to enter into confined space, must be medically examined & certified by registered doctor, confirming their 'medical fitness for working in confined space'. All necessary precautions mentioned therein shall be adhered to. An attendant shall be positioned outside a confined space for extending help during an emergency. All appropriate PPEs and air quality parameters shall be checked before entering a confined space. It shall be ensured that the piping of the equipment which has to be opened is pressure- free by checking that blinds are in place, vents are open and volume is drained. Inside confined space works, only electrical facilities / installations of 24V shall be permitted. Contractor shall ensure usage of safe & suitable arrangement of oxygen supply for individual workmen (during the course of work in confined space), if oxygen concentration is found to be less than 19.5% (v/v) there.

3.3.22 Heavy Lifts

X

The contractor shall submit detailed rigging studies plan for PDIL/ Owner approval prior to lifting equipment which cannot be erected with a crane of approx. 100 MT capacity due to constraints of its dimensions, location of foundation height, approach & weight.

X

Contractor shall generate the format no:HSE-15 "Permit for heavy lift/critical erection"

X

Prior to actual lifting activities, contractor shall check the validity of the crane inspection certificate issued by statutory/ competent authority. This requirement shall also apply to all rigging equipments utilized for the job.

X

The contractor shall, at all times, be responsible for all rigging activities.

X

The Contractor shall ensure medical fitness of all workmen who are engaged / involved in erection of equipments, vessels etc. and such fitness checks shall be carried-out every six months interval with the help of a registered medical practitioner & record shall be maintained

X

Adequate safety measures such as positive barricading, usage of appropriate PPEs, permit to work, etc. shall be taken during all heavy or critical lifts.

X

For lifting any material (irrespective of shape, size or volume), at any height, it is always advisable to prepare a Plan of Erection (PoE) taking into consideration hazards & risks associated therein – this can enable people to put their own experiences of various natures & side-by-side establish a practical method for risk-free erection / lifts. The contractor shall prepare PoE & shall document the same, when risks are identified as "medium" or "high" and the same shall be approved by its competent / qualified engineer.

3.3.23 Key Performance Indicators

The contractor shall measure an activity in both leading & trailing indicators for statistical and performance measurement. The activities pertaining to key performance indicators are covered in Monthly HSE Report (Format No. HSE-5). The contractor shall try to achieve a statistically fair record and strive for its continual improvement.

Leading Indicators viz:-:

- Number of Safety Inductions carried-out at site (for workmen & staff members)
- Number of HSE inspections carried out
- Number of "Safety Walk Through" carried-out by site-head.

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- Number of HSE shortfalls / lapses identified per contractor & closed-out in time.
- Number of Safety Meetings conducted (in-house / with contractors)
- Number of HSE Audits made (internal & external) vis-à-vis non conformances raised
- Number of HSE Awareness / Motivational program conducted by contractors
- Number of HSE Trainings conducted at site for supervisors & workmen
- Study of Near miss case reported
- Encouragements / Awards / Recognitions to workmen, job supervisors & field engineers.
- Suggestions for improvement

Trailing Indicators viz:-:

- Calculation of HSE statistics viz frequency rate, severity rate, LTA free manhours, etc
- Analysis of incidents / accidents (nature, severity, types etc.)
- Study of Incident / Accident with respect to :-
 - f* Variety
 - f* Period of the year / project span
 - f* Timings of the incident / accident
 - f* Age profile of victims
 - f* Body parts involved
 - Penalty levied for causing incident / accident

3.3.24 Unsuitable Land Conditions

Contractor shall take appropriate measures and necessary work permits/clearances if work is to be done in or around marshy areas, river crossings, mountains, monuments, etc. The Contractor shall make right assessment and take all necessary action for developing work areas to make them safe & suitable for crane operations or other vehicular movement before carrying out any project related activity / operation. Contractor shall take all necessary actions to make the surroundings of its site establishments (site office, stores, lay-down area etc.) work-worthy safe and secure.

3.3.25 Under Water Inspection

Contractor shall ensure that boats and other means used for transportation, surveying & investigation works shall be certified seaworthy by a recognized classification society. It shall be equipped with all life saving devices like life jackets, adequate fire protection arrangements and shall possess communication facilities like cellular phones, wireless, walkie-talkie. All divers used for seabed surveys, underwater inspections shall have required authorized license, suitable life saving kit. Number of hours of work by divers shall be limited as per regulations. PDIL/ Owner shall have the right to inspect the boat and scrutinize documents in this regard.

3.3.26 Excavation

The Contractor shall obtain permission from competent authorities prior to excavation wherever required.

The Contractor shall locate the position of buried utilities (water line, cable route, etc.) by referring to project / plant drawing / in consultation with PDIL/Owner. The Contractor shall start digging manually to locate the exact position of buried utilities & thereafter use mechanical means.

The Contractor shall keep soil heaps at least 1.5 M away from edge or a distance equal to depth of pit (whichever is more)

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The Contractor shall maintain sufficient “angle of repose” during excavation – shall also provide slope or suitable bench as decided by PDIL / Owner.

The Contractor shall arrange “battering” or “benching” wherever required for preventing collapse of edge of excavations.

The Contractor shall identify & arrange de-watering pump or well-point system to prevent earth collapse due to heavy rain / influx of underground water.

The Contractor shall arrange protective fencing / barricading with warning signal around excavated pits, trenches, etc. along with minimum 2 (two) entries, exits / escape ladders.

The Contractor must avoid “underpinning” / under-cutting to prevent collapse of chunk of earth during excavation

The Contractor shall use “stoppers” to prevent over-run of vehicle wheels at the edge of excavated pits / trenches.

The Contractor shall arrange strengthening of “shoring” & “strutting” proactively to avoid collapse of earth / edges due to vehicular movement in close proximity of excavated areas / pits / trenches, etc.

3.4 Tool Box Talks (TBT)

Contractor shall conduct daily TBT with workers prior to start of work and shall maintain proper record of the meeting. A suggested format is given below. The TBT is to be conducted by the immediate supervisor of the workers

The Contractor shall conduct TBT before start of every morning or evening shift or night shift activities, for alerting the workers on specific hazards and their appropriate dos & don'ts. The Contractor shall provide sufficient rests to the site workmen and their foremen to avert fatigue & thereby endangering their lives during the course of site works.

TOOL BOX TALK RECORDING SHEET		
Date & Time		
Work Location		
Subject (Nature of work)		
Presenter		
Hazards involved		
Precautions to be taken		
Worker's Name	Signature	Section
Remarks, in any		

The topics during TBT shall include

- Hazards related to work assigned on that day and precautions to be taken.
- Any forthcoming HSE hazards/events/instruction/orders, etc.

The above record can be kept in local language, which workers can read. These records shall be made available to PDIL/ Owner whenever demanded.

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3.5 Training & Induction Programme

X

Initial induction of workers into Construction oriented activities and appraising them about the methodology of works and how to carry-out safely and the same should not be inter mixed with Tool Box Talks or HSE Training. In this regard careful action should be made & maintained for imparting HSE induction to every individual, irrespective of his task/designation/level of employment, whereas, HSE Training should be imparted to specific person/group of people who are to carry-out that specific task more than once – for example, Riggers must be trained for working at heights, welders must be trained for work in confined space, fitters/carpenters, masons must be trained for work at heights, etc.

X

Contractor shall conduct Safety induction programme on HSE for all his workers and maintain records. The Gate Pass shall be issued only to those workers who successfully qualify the Safety induction programme.

X

The Contractor shall brief the visitors about the HSE precautions which are required to be taken before their proceeding to site and make necessary arrangements to issue appropriate PPEs like Aprons, hard hats, ear-plugs, goggles & safety shoes etc., to his visitors. The Contractor shall always maintain relevant acknowledgement from visitor on providing him brief information on HSE actions.

X

Contractor shall ensure that all his personnel possess appropriate training to carry out the assigned job safely. The training should be imparted in a language understood by them and should specifically be trained about

- Potential hazards to which they may be exposed at their workplace
- Measures available for prevention and elimination of these hazards

The topics during training shall cover, at the minimum: -

- Why safety should be considered during work - explanation
- Education about hazards and precautions required
- Employees' duties & responsibilities
- Emergency and evacuation plan
- HSE requirements during project activities
- Fire fighting and First-Aid
- Use of PPEs
- Occupational health issues – dos & don'ts
- Local laws on intoxicating drinks, drugs, smoking in force
- Common environmental subjects – lighting, ventilation, vibration, smoke/fumes etc.

X

Records of the training shall be kept and submitted to PDIL/ Owner.

X

The Contractor shall make regular program for conducting Safety Training on various topics related to various activities & their safe-guarding utilizing experienced persons / outside agency / faculty. A program for Safety Training (indicative list as per Appendix –F) shall be furnished by the Contractor in its HSE Plan .

X

For offshore and jetty jobs, contractor shall ensure that all personnel deployed have undergone a structured sea survival training including use of lifeboats, basket landing, use of radio communication etc. from an agency acceptable to Owner/PDIL.

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3.6 ADDITIONAL SAFETY REQUIREMENTS FOR WORKING INSIDE A RUNNING PLANT

As a minimum, the contractor shall ensure adherence to following safety requirements while working in or in the close vicinity of an operating plant:

- a) Contractor shall obtain permits for Hot work, Cold work, Excavation and Confined Space from Owner in the prescribed format.
- b) The contractor shall monitor record and compile list of his workers entering the operational plant/unit each day and ensure & record their return after completing the job.
- c) Contractor's workers and staff members shall use designated entrances and proceed by designated routes to work areas only assigned to them. The workers shall not be allowed to enter units' area, tanks area, pump rooms, etc. without work authorization permit.
- d) Work activities shall be planned in such a way so as to minimize the disruption of other activities being carried out in an operational plant/unit and activities of other contractors.
- e) The contractor shall submit a list of all chemicals/toxic substances that are intended to be used at site and shall take prior approval of the Owner.
- f) Specific training on working in a hydrocarbon plant shall be imparted to the work force and mock drills shall be carried out for Rescue operations/First-Aid measures.
- g) Proper barricading/cordoning of the operational units/plants shall be done before starting the construction activities. No unauthorized person shall be allowed to trespass. The height and overall design of the barricading structure shall be finalized in consultation with the Owner and shall be got approved from the Owner.
- h) Care shall be taken to prevent hitting underground facilities such as electrical cables, hydrocarbon piping during execution of work.
- i) Barricading with water curtain shall be arranged in specific/critical areas where hydrocarbon vapors are likely to be present such as near horton spheres or tanks. Positioning of fire tenders (from owner) shall also be ensured during execution of critical activities.
- j) Emergency evacuation plan shall be worked out and all workmen shall be apprised about evacuation routes. Mock drill operations may also be conducted.
- k) Flammable gas test shall be conducted prior to any hot work using appropriate measuring instruments. Sewers, drains, vents or any other gas escaping points shall be covered with flame retardant tarpaulin.
- l) Respiratory devices shall be kept handy while working in confined zones where there is a danger of inhalation of poisonous gases. Constant monitoring of presence of Gas/ Hydrocarbon shall be done.
- m) Clearance shall be obtained from all parties before starting hot tapping, patchwork on live lines and work on corroded tank roof.
- n) Positive isolation of line/equipment by blinding for welding/cutting/grinding shall be done. Closing of valve will not be considered sufficient for isolation.

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- o) Welding spatters shall be contained properly and in no case shall be allowed to fall on the ground containing oil. Similar care shall be taken during cutting operations.
- p) The vehicles, cranes, engines, etc. shall be fitted with spark arresters on the exhaust pipe and got it approved from Safety Department of the Owner.
- q) Plant air should not be used to clean any part of the body or clothing or use to blow off dirt on the floor.
- r) Gas detectors should be installed in gas leakage prone areas as per requirement of Owner's plant operation personnel.
- s) Experienced full time safety personnel shall be exclusively deployed to monitor safety aspects in running plants.

3.7 Self Assessment And Enhancement

The contractor shall develop a method of check & balance through self assessment & enhancement techniques and shall explore the opportunities for continual improvement in the HSE system.

3.8 HSE Promotion

The contractor shall encourage his workforce to promote HSE efforts at workplace by way of organizing workshops/seminars/training programmes, celebrating HSE awareness weeks & National Safety Day, conducting quizzes & essay competitions, distributing pamphlets, posters & material on HSE, providing incentives for maintaining good HSE practices and granting incentives / bonus for completing the job without any lost time accident.

3.9 Lock Out and Tag Out (LOTO) for isolation of energy source

x

Contractor shall follow the LOTO/Isolation procedure of owner for all energy source

x isolations installed/under purview by /of owner ie. "Brown field"

For all the other energy source (not under purview of client/owner) i.e "Green field"

Contractor shall develop a system to ensure the isolation of equipments, pipelines, Vessel, electrical panels from the energy source covering following as minimum:-

- Identification of all energy source viz electrical, mechanical, hydraulic, pneumatic, chemical, thermal, gravitational, radiation and other forms of stored or kinetic energy.
- Establishing the energy isolation devices viz: manually operated electrical circuit breakers, disconnection switches, blind flanges, etc
- Installation of Lock Out devices for preventing the inadvertent release of stored energy and Tag Out devices ("Danger", "Do Not operate" or Do not Remove" tags) to indicate that testing, maintenance or servicing is underway and the device cannot be operated until the tag out device is removed.
- Lock Out and Tag out log book
- Permit for isolation and de-isolation of energy source as per format NO: HSE-16
- Availability of competent persons like experienced operators at substations, pump

x house, units, etc. ; supervisors,etc.

Contractor shall ensure that all the sources are locked out and tagged properly before giving

x clearance to start the job.

After the completion of job, contractor shall ensure all tools and tackles are removed and nobody is present in the working area and signing on LOTO log book.

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x

Only on confirmation of above the contractor will remove their lock and tag from the isolation points and give instructions for energizing the same. Only the person carrying out the task shall himself carry the key for the lock in /Lock out.

4.0 DETAILS OF HSE MANAGEMENT SYSTEM BY CONTRACTOR

4.1 On Award Of Contract

The Contractor shall submit a comprehensive Health, Safety and Environment Plan or programme for approval by PDIL/Owner prior to start of work. The Contractor shall participate in the pre-start meeting with PDIL/Owner to finalize HSE Plans which shall including the following:

- HSE policy & Objectives
- Job procedure to be followed by the Contractor for construction activities including handling of equipments, scaffolding, electric installations, etc. describing the risks involved, actions to be taken and methodology for monitoring each activity. Indicative list of procedures is enclosed as Annexure-H
- PDIL/Owner review/audit requirement.
- Organization structure along with responsibility and authority, on HSE activities.
- Administrative & disciplinary steps involving implementation of HSE requirements
- Emergency evacuation plan/ procedures for site and labour camps
- Job Safety Analysis for high risk jobs
- Procedures for reporting & investigation of accidents and near misses.
- HSE Inspection
- HSE Training programmes at project site
- HSE Awareness programmes, at project site
- Reference to Rules, Regulations and statutory requirements.
- HSE documentation viz reporting, analysis & record keeping.

4.2 During Job Execution

Contractor shall implement approved Health, Safety and Environment management programme including but not limited to as brought out under para 3.0. Contractor shall also ensure:

- x to arrange workmen compensation insurance, registration under ESI Act, third party liability insurance, registration under BOCW Act, etc, as applicable.
- x to arrange all HSE permits before start of activities (as applicable), like permits for hot work, working at heights (Refer Format No. HSE-6), confined space (Refer Format No. HSE-7), Radiation Work Permit (Refer Format No. HSE-8), Demolishing/ Dismantling Work Permit (Refer Format No. HSE-9), Permit for erection/modification & dismantling of scaffolding (Refer Format No: HSE-14), Permit for heavy lift/critical erection (Refer Format No: HSE-15), Permit for energy Isolation & De-isolation" (HSE-16), storage of chemical / explosive materials & its use and implement all precautions mentioned therein. In this regard, requirements of *Oil industry Safety Directorate Standard No. Std -105 "Work Permit Systems"* shall be complied with while working in existing Oil or Gas processing plants. List of the persons involved shall be maintained as annexure to the work permit issued for a particular activity.
- x to submit, timely, the completed checklist on HSE activities in Format No. HSE-1, Monthly HSE report in Format No. HSE-5 (use of web based package (www.PDIL.co.in/conthse) is compulsory wherever the facility is available else a hard copy is to be submitted), accident/incident reports, investigation reports etc. as per PDIL/Owner requirements. Compliance of instructions on HSE shall be done by Contractor and informed urgently to PDIL/Owner.

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- x that his top most executive at site attends all the Safety Committee/HSE meetings arranged by PDIL/Owner and carries out safety walk through regularly. Only in case of his absence from site that a second senior most person shall be nominated by him, in advance, and communicated to PDIL/Owner for performing the above tasks.
- x display at site office and at prominent locations HSE Policy, caution boards, list of hospitals, emergency services available, safety signs like Men at work, Speed Limits, Hazardous Area, various do's & don'ts, etc.
- x provide posters, banners for safe working to promote safety consciousness.
- x identify, assess, analyze & mitigate the construction hazards & incorporate relevant control measures before actually executing site works. (HIRAC = Hazard Identification, Risk Analysis and Control).
- x arrange testing, examination, inspection of own as well as borrowed construction equipments / machinery (stationary & mobile) before being used at site and also at periodical interval, through own resources and also by 3rd party competent agencies (as deemed fit in statutes). Records of such test, examination etc. shall be maintained & shall be submitted to PDIL/Owner as & when asked for.
- x carryout audits/inspection (internal & external) at his works as well as sub contractor works as per approved HSE plan/procedure/programme & submit the compliance reports of identified shortfalls for PDIL/Owner review.
- x arranging HSE training for site workmen (of his own & sub contractors) through internal or external faculty at periodical intervals.
- x assistance & cooperate during HSE audits by PDIL/Owner or any other 3rd party and submit compliance report.
generate & submit of HSE records/report as per this specification.
- x apprise PDIL/Owner on HSE activities at site regularly.
- x carry-out all dismantling activities safely, with prior approval of PDIL/Owner representative.
- x The Contractor shall ensure that "Hot works" and painting works do not continue at the same place / location at project site for which chance or probability of "fire" incident exists.

4.3 During Short Listing Of The Sub-Contractors

The contractor shall review the HSE management system of the sub-contractors in line with the requirements given in this specification. The contractor shall be held responsible for the shortcomings observed in the HSE management system of the sub-contractor(s) during execution of the job.

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5.0 RECORDS

At the minimum, the contractor shall maintain/ submit HSE records in the following reporting formats/:

Safety Walk Through Report	HSE-1
Accident/ Incident Report	HSE-2
Supplementary Accident/ Incident Investigation report	HSE-3
Near Miss Incident Report	HSE-4
Monthly HSE Report	HSE-5
Permit for working at height	HSE-5
Permit for working in confined space	HSE-7
Permit for radiation work	HSE-8
Permit for demolishing/ dismantling	HSE-9
Daily Safety checklist	HSE-10
House keeping Assessment & compliance	HSE-11
Inspection of temporary electrical booth/installation	HSE-12
Inspection for scaffolding	HSE-13
Permit for erection/modification & dismantling of scaffolding	HSE-14
Permit for heavy lift/critical erection.	HSE-15
Permit for Energy isolation and de-isolation.	HSE-16
Permit for Excavation	HSE-17
Inspection reports of Equipment/tools/tackles	*
Report of Toolbox talks	As indicated in specification
PPE issue report/register	*
Site inspection reports	*
Training records	*

(* The formats shall be developed in consultation with PDIL/Owner

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**APPENDIX-A
(Sheet 1 of 2)**

A. IS CODES ON HSE

SP: 53	Safety code for the use, Care and protection of hand operated tools.
IS: 838	Code of practice for safety & health requirements in electric and gas welding and cutting operations
IS: 1179	Eye & Face precautions during welding, equipment etc.
IS: 1860	Safety requirements for use, care and protection of abrasive grinding wheels.
IS: 1989 (Pt -II)	Leather safety boots and shoes
IS: 2925	Industrial Safety Helmets
IS: 3016	Code of practice for fire safety precautions in welding & cutting operation.
IS: 3043	Code of practice for earthing
IS: 3764	Code of safety for excavation work
IS: 3786	Methods for computation of frequency and severity rates for industrial injuries and classification of industrial accidents
IS: 3696	Safety Code of scaffolds and ladders
IS: 4083	Recommendations on stacking and storage of construction materials and components at site
IS: 4770	Rubber gloves for electrical purposes
IS: 5121	Safety code for piling and other deep foundations
IS: 5216 (Pt-I)	Recommendations on Safety procedures and practices in electrical works
IS: 5557	Industrial and Safety rubber lined boots
IS: 5983	Eye protectors
IS: 6519	Selection, care and repair of Safety footwear
IS: 6994 (Pt-I)	Industrial Safety Gloves (Leather & Cotton Gloves)
IS: 7293	Safety Code for working with construction Machinery
IS: 8519	Guide for selection of industrial safety equipment for body protection
IS: 9167	Ear protectors
IS: 11006	Flash back arrestor (Flame arrestor)
IS: 11016	General and safety requirements for machine tools and their operation
IS: 11057	Specification for Industrial safety nets
IS: 11226	Leather safety footwear having direct moulded rubber sole
IS: 11972	Code of practice for safety precaution to be taken when entering a sewerage system
IS: 13367	Code of practice-safe use of cranes
IS: 13416	Recommendations for preventive measures against hazards at working place

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B. INTERNATIONAL STANDARDS ON HSE

Safety Glasses	:	ANSI Z 87.1, ANSI ZZ 87.1, AS 1337, BS 2092, BS 1542, BS 679, DIN 4646/ 58311
Safety Shoes	:	ANSI Z 41.1, AS 2210, EN 345
Hand Gloves	:	BS 1651
Ear Muffs	:	BS 6344, ANSI S 31.9
Hard Hat	:	ANSI Z 89.1/89.2, AS 1808 , BS 5240, DIN 4840
Goggles	:	ANSI Z 87.1
Face Shield	:	ANSI Z 89.1
Breathing Apparatus	:	BS 4667, NIOSH
Welding & Cutting	:	ANSI Z 49.1
Safe handling of compressed: P-1		(Compressed Gas Association Gases in cylinders 1235 Jefferson Davis Highway, Arlington VA 22202 - USA)
Full body harness	:	EN-361
Lanyard	:	EN-354
Karabiner	:	EN-362 and EN-12275

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APPENDIX-B

DETAILS OF FIRST AID BOX

SL. NO.	DESCRIPTION	QUANTITY
1.	Small size Roller Bandages, 1 Inch Wide (Finger Dressing small)	6 Pcs.
2.	Medium size Roller Bandages, 2 Inches Wide (Hand & Foot Dressing)	6 Pcs.
3.	Large size Roller Bandages, 4 Inches Wide (Body Dressing Large)	6 Pcs.
4.	Large size Burn Dressing (Burn Dressing Large)	4 Pkts.
5.	Cotton Wool (20 gms packing)	4 Pkts.
6.	Antiseptic Solution Dettol (100 ml.) or Savlon	1 Bottle
7.	Mercurochrome Solution (100 ml.) 2% in water	1 Bottle
8.	Ammonia Solution (20 ml.)	1 Bottle
9.	A Pair of Scissors	1 Piece
10.	Adhesive Plaster (1.25 cm X 5 m)	1 Spool
11.	Eye pads in Separate Sealed Pkt.	4 pcs.
12.	Tourniquet	1 No.
13.	Safety Pins	1 Dozen
14.	Tinc. Iodine/ Betadin (100 ml.)	1 Bottle
15.	Polythene Wash cup for washing eyes	1 No.
16.	Potassium Permanganate (20 gms.)	1 Pkt.
17.	Tinc. Benzoine (100 ml.)	1 Bottle
18.	Triangular Bandages	2 Nos.
19.	Band Aid Dressing	5 Pcs.
20.	Iodex/Moov (25 gms.)	1 Bottle
21.	Tongue Depressor	1 No.
22.	Boric Acid Powder (20 gms.)	2 Pkt.
23.	Sodium Bicarbonate (20 gms.)	1 Pkt.
24.	Dressing Powder (Nebasulf) (10 gms.)	1 Bottle
25.	Medicinal Glass	1 No.
26.	Duster	1 No.
27.	Booklet (English & Local Language)	1 No. each
28.	Soap	1 No.
29.	Toothache Solution	1 No.
30.	Vicks (22 gms.)	1 Bottle
31.	Forceps	1 No.
32.	Note Book	1 No.
33.	Splints	4 Nos.
34.	Lock	1 Piece
35.	Life Saving/Emergency/Over-the counter Drugs	As decided at site

Box size: 14" x 12" x 4"

Note : The medicines prescribed above are only indicative. Equivalent medicines can also be used.
A prescription, in this regard, shall be required from a qualified Physician.

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APPENDIX-C

TYPE OF FIRES VIS-À-VIS FIRE EXTINGUISHERS

Fire ↓ Extinguisher →	Water	Foam	CO ₂	Dry Powder	Multi purpose (ABC)
Originated from paper, clothes, wood	D	D	can control minor surface fires	can control minor surface fires	D
Inflammable liquids like alcohol, diesel, petrol, edible oils, bitumen	2	D	D	D	D
Originated from gases like LPG, CNG, H ₂	2	2	D	D	D
Electrical fires	2	2	D	D	D

LEGEND : D : CAN BE USED
 2 : NOT TO BE USED

Note: Fire extinguishing equipment must be checked at least once a year and after every use by an authorized person. The equipment must have an inspection label on which the next inspection date is given. Type of extinguisher shall clearly be marked on it.

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APPENDIX-D

List of Statutory Acts & Rules Relating to HSE

- The Indian Explosives Act and Rules
- The Motor Vehicle Act and Central Motor Vehicle Rules
- The Factories Act and concerned Factory Rules
- The Petroleum Act and Petroleum Rules
- The Workmen Compensation Act
- The Gas Cylinder Rules and the Static & Mobile Pressure Vessels Rules
- The Indian Electricity Act and Rules
- The Indian Boiler Act and Regulations
- The Water (Prevention & Control & Pollution) Act
- The Water (Prevention & Control of Pollution) Cess Act
- The Mines & Minerals (Regulation & Development) Act
- The Air (Prevention & Control of Pollution) Act
- The Atomic Energy Act
- The Radiation Protection Rules
- The Indian Fisheries Act
- The Indian Forest Act
- The Wild Life (Protection) Act
- The Environment (Protection) Act and Rules
- The Hazardous Wastes (Management & Handling) Rules
- The Manufacturing, Storage & import of Hazardous Chemicals Rules
- The Public Liability Act
- The Building and Other Construction Workers (Regulation of Employment and Condition of service) Act
- Other statutory acts Like EPF, ESIS, Minimum Wage Act.

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APPENDIX-E (Sheet 1 of 12)

CONSTRUCTION HAZARDS, THEIR EFFECTS & PREVENTIVE MEASURES

ACTIVITY	TYPE OF HAZARD	EFFECT OF HAZARD	PREVENTIVE MEASURES
(A) EXCAVATION Pit Excavation upto 3.0m	Falling into pit	Personal injury	Provide guard rails/ barricade with warning signal Provide at least two entries/ exits. <u>Provide escape ladders.</u>
	Earth Collapse	Suffocation/ Breathlessness Buried	Provide suitable size of shoring and strutting, if required. Keep soil heaps away from the edge equivalent to 1.5m or depth of pit whichever is more. Don't allow vehicles to operate too close to excavated areas. Maintain at least 2m distance from edge of cut. Maintain sufficient angle of repose. Provide slope not less than 1:1 and suitable bench of 0.5m width at every 1.5m depth of excavation in all soils except hard rock. <u>Battering/benching the sides.</u>
	Contact with buried electric cables Gas/ Oil Pipelines	Electrocution Explosion	Obtain permission from competent authorities, prior to excavation, if required. Locate the position of buried utilities by referring to plant drawings. Start digging manually to locate the exact position of buried utilities and thereafter use <u>mechanical means.</u>
Pit Excavation beyond 3.0m	Same as above plus Flooding due to excessive rain/ underground water	Can cause drowning situation	Prevent ingress of water Provide ring buoys Identify and provide suitable size dewatering pump or well point system
	Digging in the vicinity of existing Building/ Structure	Building/Structure may collapse Loss of health & wealth	Obtain prior approval of excavation method from local authorities. Use under-pining method <u>Construct retaining wall side by side.</u>
	Movement of vehicles/ equipments close to the edge of cut.	May cause cave-in or slides. Persons may get buried.	Barricade the excavated area with proper lighting arrangements Maintain at least 2m distance from edge of cut and use stop blocks to prevent over-run <u>Strengthen shoring and strutting</u>

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APPENDIX-E: (Sheet 2 of 12)

CONSTRUCTION HAZARDS, THEIR EFFECTS & PREVENTIVE MEASURES (...Contd.)

ACTIVITY	TYPE OF HAZARD	EFFECT OF HAZARD	PREVENTIVE MEASURES
Narrow deep excavations for pipelines, etc.	Same as above plus Frequent cave-in or slides	May cause severe injuries or prove fatal	Battering/benching of sides Provide escape ladders
	Flooding due to Hydro- static testing	May arise drowning situation	Same as above plus Bail out accumulated water Maintain adequate ventilation.
Rock by excavation blasting	Improper handling of explosives	May prove fatal	Ensure proper storage, handling & carrying of explosives by trained personnel. Comply with the applicable explosive acts & rules.
	Uncontrolled explosion	May cause severe injuries or prove fatal	Allow only authorized persons to perform blasting operations. Smoking and open flames are to be strictly prohibited
	Scattering of stone pieces in atmosphere	Can hurt people	Use PPE like goggles, face mask, helmets etc.
Rock excavation by blasting (Contd)	Entrapping of persons/ animals.	May cause severe injuries or prove fatal	Barricade the area with red flags and blow siren before blasting.
	Misfire	May explode suddenly	Do not return to site for at least 20 minutes or unless announced safe by designated person.
Piling Work	Failure of pile-driving equipment	Can hurt people	Inspect Piling rigs and pulley blocks before the beginning of each shift.
	Noise pollution	Can cause deafness and psychological imbalance.	Use personal protective equipments like ear plugs, muffs, etc.
	Extruding rods/casing	Can hurt people	Barricade the area and install sign boards Provide first-aid
	Working in the vicinity of 'Live-Electricity'	Can cause electrocution/ Asphyxiation	Keep sufficient distance from Live-Electricity as per IS code. Shut off the supply, if possible Provide artificial/rescue breathing to the injured
(B) CONCRETING	Air pollution by cement	May affect Respiratory System	Wear respirators or cover mouth and nose with wet cloth.
	Handling of ingredients	Hands may get injured	Use gloves & other PPE.
	Protruding reinforcement rods.	Feet may get injured	Use Provide platform above reinforcement for movement of workers.

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APPENDIX-E : (Sheet 3 of 12)

CONSTRUCTION HAZARDS, THEIR EFFECTS & PREVENTIVE MEASURES (...Contd.)

ACTIVITY	TYPE OF HAZARD	EFFECT OF HAZARD	PREVENTIVE MEASURES
	Earthing of electrical mixers, vibrators, etc. not done.	Can cause electrocution/ asphyxiation	Ensure earthing of equipments and proper functioning of electrical circuit before commencement of work.
	Falling of materials from height	Persons may get injured	Use hard hats Remove surplus material immediately from work place. Ensure lighting arrangements during night hours
	Continuous pouring by same gang	Cause tiredness of workers and may lead to accident.	Insist on shift pattern Provide adequate rest to workers between subsequent pours.
	Revolving of concrete mixer/ vibrators	Parts of body or clothes may get entrapped.	Allow only mixers with hopper Provide safety cages around moving motors Ensure proper mechanical locking of vibrator
Super-structure	Same as above plus Deflection in props or shuttering material	Shuttering/props may collapse and prove fatal	Avoid excessive stacking on shuttering material Check the design and strength of shuttering material before commencement of work Rectify immediately the deflection noted during concreting.
	Passage to work place	Improperly tied and designed props/planks may collapse	Ensure the stability and strength of passage before commencement of work. Do not overload and stand under the passage.
(C) REINFOR- CEMENT	Curtailment and binding of rods	Persons may get injured	Use PPE like gloves, shoes, helmets, etc. Avoid usage of shift tools
	Carrying of rods for short distances/at heights	Workers may get injured their hands and shoulders.	Provide suitable pads on shoulders and use safety gloves. Tie up rods in easily liftable bundles Ensure proper staging.
	Checking of clear distance/ cover with hands	Rods may cut or injure the fingers	Use measuring devices like tape, measuring rods, etc.
	Hitting projected rods and standing on cantilever rods.	Persons may get injured and fell down	Use safety shoes and avoid standing unnecessarily on cantilever rods Avoid wearing of loose clothes

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CONSTRUCTION HAZARDS, THEIR EFFECTS & PREVENTIVE MEASURES (...Contd.)

ACTIVITY	TYPE OF HAZARD	EFFECT OF HAZARD	PREVENTIVE MEASURES
	Falling of material from height	May prove fatal	Use helmets Provide safety nets
	Transportation of rods by trucks/ trailers	Protruded rods may hit the persons	Use red flags/lights at the ends Do not protrude the rods in front of or by the side of driver's cabin. Do not extend the rods 1/3 rd of deck length or 1.5m whichever is less
(D)WELDING AND GAS CUTTING	Welding radiates invisible ultraviolet and infra-red rays	Radiation can damage eyes and skin.	Use specified shielding devices and other PPE of correct specifications. Avoid thoriated tungsten electrodes for GTAW
	Improper placement of oxygen and acetylene cylinders	Explosion may occur	Move out any leaking cylinder Keep cylinders in vertical position Use trolley for transportation of cylinders and chain them Use flashback arrestors
	Leakage/ cuts in hoses	May cause fire	Purge regulators immediately and then turn off Never use grease or oil on oxygen line connections and copper fittings on acetylene lines Inspect regularly gas carrying hoses Always use red hose for acetylene & other fuel gases and black for oxygen
	Opening-up of cylinder	Cylinder may burst	Always stand back from the regulator while opening the cylinder Turn valve slowly to avoid bursting Cover the lug terminals to prevent short circuiting
	Welding of tanks, container or pipes storing flammable liquids	Explosion may occur	Empty & purge them before welding Never attach the ground cable to tanks, container or pipe storing flammable liquids Never use LPG for gas cutting

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CONSTRUCTION HAZARDS, THEIR EFFECTS & PREVENTIVE MEASURES ...(Contd.)

ACTIVITY	TYPE OF HAZARD	EFFECT OF HAZARD	PREVENTIVE MEASURES
(E) RADIOGRAPHY	Ionizing radiation	Radiations may react with the skin and can cause cancer, skin irritation, dermatitis, etc.	Ensure Safety regulations as per BARC/AERB before commencement of job. Cordon off the area and install Radiation warning symbols Restrict the entry of unauthorized persons Wear appropriate PPE and film badges issued by BARC/AERB
	Transportation and Storage of Radiography source	Same as above	Never touch or handle radiography source with hands Store radiography source inside a pit in an exclusive isolated storage room with lock and key arrangement. The pit should be approved by BARC/AERB. Radiography source should never be carried either in passenger bus or in a passenger compartment of trains. BARC/AERB has to be informed before source movement. Permission from Director General of Civil Aviation is required for booking radio isotopes with airlines.
	Loss of Radio isotope	Same as above	Try to locate with the help of Survey Meter. Inform BARC/AERB (*)
(F) ELECTRICAL INSTALLATION AND USAGE	Short circuiting	Can cause Electrocutation or Fire	Use rubberized hand gloves and other PPE Don't lay wires under carpets, mats or door ways. Allow only licensed electricians to perform on electrical facilities Use one socket for one appliance Ensure usage of only fully insulated wires or cables Don't place bare wire ends in a socket Ensure earthing of machineries and equipments Do not use damaged cords and avoid temporary connections Use spark-proof/flame proof type field distribution boxes.

(*) Atomic Energy Regulatory Board (AERB),
Bhabha Atomic Research Centre (BARC)
Anushaktinagar, Mumbai – 400 094

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CONSTRUCTION HAZARDS, THEIR EFFECTS & PREVENTIVE MEASURES (...Contd.)

ACTIVITY	TYPE OF HAZARD	EFFECT OF HAZARD	PREVENTIVE MEASURES
			Do not allow open/bare connections Provide all connections through ELCB Protect electrical cables/equipment's from water and naked flames <u>Check all connections before energizing</u>
	Overloading of Electrical System	Bursting of system can occur which leads to fire	Display voltage and current ratings prominently with 'Danger' signs. Ensure approved cable size, voltage grade and type Switch off the electrical utilities when not in use Do not allow unauthorized connections. <u>Ensure proper grid wise distribution of Power</u>
	Improper laying of overhead and underground transmission lines/cables	Can cause electrocution and prove fatal	Do not lay unarmoured cable directly on ground, wall, roof of trees Maintain at least 3m distance from HT cables All temporary cables should be laid at least 750 mm below ground on 100 mm fine sand overlying by brick soling Provide proper sleeves at crossings/ inter-sections Provide cable route markers indicating the type and depth of cables at intervals not exceeding 30m and at the diversions/termination
(G) FIRE PREVENTION AND PROTECTION	Small fires can become big ones and may spread to the surrounding areas	Cause burn injuries and may prove fatal	In case a fire breaks out, press fire alarm system and shout "Fire, Fire" Keep buckets full of sand & water/ fire extinguishing equipment near hazardous locations Confine smoking to 'Smoking Zones' only. Train people for using specific type of fire fighting equipments under different classes of fire Keep fire doors/shutters, passages and exit doors unobstructed Maintain good housekeeping and first-aid boxes (for details refer Appendix-B) Don't obstruct access to Fire extinguishers. Do not use elevators for evacuation during fire. Maintain lightning arrestors for elevated structures Stop all electrical motors with internal combustion

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CONSTRUCTION HAZARDS, THEIR EFFECTS & PREVENTIVE MEASURES (...Contd.)

ACTIVITY	TYPE OF HAZARD	EFFECT OF HAZARD	PREVENTIVE MEASURES
			Move the vehicles from dangerous locations Remove the load hanging from the crane booms <u>Remain out of the danger areas.</u>
	Improper selection of Fire extinguisher	It may not extinguish the fire	Ensure usage of correct fire extinguisher meant for the specified fire (for details refer Appendix-C). Do not attempt to extinguish Oil and electric fires with water. Use foam cylinders/CO ₂ /sand or earth.
	Improper storage of highly inflammable substances	Same as above	Maintain safe distance of flammable substances from source of ignition Restrict the distribution of flammable materials to only min. necessary amount Construct specifically designed fuel storage facilities Keep chemicals in cool and dry place away from heat. Ensure adequate ventilation Before welding operation, remove or shield the flammable material properly Store flammable materials in stable racks, correctly labeled preferably with catchment trays. <u>Wipe off the spills immediately</u>
	Short circuiting of electrical system	Same as above Can cause Electrocutation	Don't lay wires under carpets, mats or door ways Use one socket for one appliance. Use only fully insulated wires or cables Do not allow open/bare connections Provide all connections through ELCB <u>Ensure earthing of machineries and equipments</u>
(H) VEHICULAR MOVEMENT	Crossing the Speed Limits (Rash driving)	Personal injury	Obey speed limits and traffic rules strictly Always expect the unexpected and be a defensive driver Use seat belts/helmets Blow horn at intersections and during overtaking operations. Maintain the vehicle in good condition <u>Do not overtake on curves, bridges and slopes</u>
	Adverse weather condition	Same as Above	Read the road ahead and ride to the left Keep the wind screen and lights clean Do not turn at speed. Recognize the hazard, understand the defense and act correctly in time.

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CONSTRUCTION HAZARDS, THEIR EFFECTS & PREVENTIVE MEASURES (...Contd.)

ACTIVITY	TYPE OF HAZARD	EFFECT OF HAZARD	PREVENTIVE MEASURES
	Consuming alcohol before and during the driving operation	Same as above	Alcohol and driving do not mix well. Either choose alcohol or driving. If you have a choice between hitting a fixed object or an on-coming vehicle, hit the fixed object Quit the steering at once and become a passenger. Otherwise take sufficient rest and then drive. Do not force the driver to drive fast and round the clock. <u>Do not day dream while driving</u>
	Falling objects/ Mechanical failure	May prove fatal	Ensure effective braking system, adequate visibility for the drives, reverse warning alarm.. Proper maintenance of the vehicle as per <u>manufacturer instructions</u>
(I) PROOF TESTING (HYDROSTATIC /PNEUMATIC TESTING)	Bursting of piping Collapse of tanks Tanks flying off	May cause injury and prove fatal	Prepare test procedure & obtain PDIL/owner's approval Provide separate gauge for pressurizing pump and piping/equipment Check the calibration status of all pressure gauges, dead weight testers and temperature recorders Take dial readings at suitable defined intervals and ensure most of them fall between 40-60% of the gauge scale range Provide safety relief valve (set at pressure slightly higher than test pressure) while testing with air/ nitrogen Ensure necessary precautions, stepwise increase in pressure, tightening of bolts/nuts, grouting, etc. before and during testing Keep the vents open before opening any valve while draining out of water used for hydro-testing of tanks. Pneumatic testing involves the hazard of released energy stored in compressed gas. Specific care must therefore be taken to minimize the chance of brittle failure during a pneumatic leak test. Test temperature is important in this regard and must be considered when the designer chooses the material of construction.

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APPENDIX-E : (Sheet 9 of 12)

CONSTRUCTION HAZARDS, THEIR EFFECTS & PREVENTIVE MEASURES (...Contd.)

ACTIVITY	TYPE OF HAZARD	EFFECT OF HAZARD	PREVENTIVE MEASURES
			<p>A pressure relief device shall be provided, having a set pressure not higher than the test pressure plus the lesser of 345 KPa (50 psi) or 10% of the test pressure.</p> <p>The gas used as test fluid, if not air, shall be <u>nonflammable and nontoxic</u>.</p>
(J) WORKING AT HEIGHTS	Person can fall down	May sustain severe injuries or prove fatal	<p>Provide guard rails/barricade at the work place</p> <p>Use PPE like full body harness, life line, helmets, safety shoes, etc.</p> <p>Obtain a permit before starting the work at height above 3 meters</p> <p>Fall arrest and safety nets, etc. must be installed</p> <p>Provide adequate working space (min. 0.6 m)</p> <p>Tie/weld working platform with fixed support</p> <p>Use roof top walk ladder while working on a sloping roofs</p> <p><u>Avoid movement on beams</u></p>
		May hit the scrap/material stacked at the ground or in between	<p>Keep the work place neat and clean</p> <p>Remove the scrap immediately</p>
	Material can fall down	May hit the workers working at lower levels and prove fatal	<p>Same as above plus</p> <p>Do not throw or drop materials or equipment from height. I.e. do not <i>bomb</i> materials</p> <p>All tools to be carried in a tool-kit</p> <p>Bag or on working uniform</p> <p>Remove scrap from the planks</p> <p>Ensure wearing of helmet by the workers <u>working at lower levels</u></p>
(K) CONFINED SPACES	Suffocation/drowning	Unconsciousness, death	<p>Use respiratory devices, if reqd.</p> <p>Avoid over crowding inside a confined space</p> <p>Provide Exhaust fans for ventilation</p> <p>Do not wear loose clothes, neck ties, etc</p> <p>Fulfill conditions of the permit</p>

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CONSTRUCTION HAZARDS, THEIR EFFECTS & PREVENTIVE MEASURES (...Contd.)

ACTIVITY	TYPE OF HAZARD	EFFECT OF HAZARD	PREVENTIVE MEASURES
			Check for presence of hydrocarbons, O ₂ level Obtain work permit before entering a confined space Ensure that the connected piping of the equipment which is to be opened is pressure free, fluid has been drained, vents are open and piping is positively isolated by a blind flange
	Presence of foul smell and toxic substances	Inhalation can pose threat to life	Same as above plus Check for hydrocarbon and Aromatic compounds before entering a confined space Depute one person outside the confined space for continuous monitoring and for extending help in case of an emergency
	Ignition/ flame can cause fire	Person may sustain burn injuries or explosion may occur	Keep fire extinguishers at a hand distance Remove surplus material and scrap immediately Do not smoke inside a confined space Do not allow gas cylinders inside a confined space Use low voltage (24V) lamps for lighting Use tools with air motors or electric tools with max. voltage of 24V Remove all equipments at the end of the day
(L) HANDLING AND LIFTING EQUIPMENTS	Failure of load lifting and moving equipments	Can cause accident and prove fatal	Avoid standing under the lifted load and within the operating radius of cranes Check periodically oil, brakes, gears, horns and tyre pressure of all moving machinery Check quality, size and condition of all chain pulley blocks, slings, U-clamps, D-shackles, wire ropes, etc. Allow crane to move only on hard, firm and leveled ground. Allow lifting slings as short as possible and check gunny packings at the friction points Do not allow crane to tilt its boom while moving Install Safe Load Indicator Ensure certification by applicable authority

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CONSTRUCTION HAZARDS, THEIR EFFECTS & PREVENTIVE MEASURES (...Contd.)

ACTIVITY	TYPE OF HAZARD	EFFECT OF HAZARD	PREVENTIVE MEASURES
	Overloading of lifting equipments	Same as above	Safe lifting capacity of derricks and winches written on them shall be got verified The max. safe working load shall be marked on all lifting equipments Check the weight of columns and other heavy items painted on them and accordingly decide about the crane capacity, boom and angle of erection Allow only trained operators and riggers during crane operation.
	Overhead electrical wires	Can cause electrocution and fire	Do not allow boom or other parts of crane to come within 3m reach of overhead HT cables Hook and load being lifted shall preferably remain in full visibility of crane operators.
(M) SCAFFOLDING, FORMWORK AND LADDERS	Person can fall down	Person May sustain severe injuries and prove fatal	Provide guard rails for working at height Face ladder while climbing and use both hands. Ladders shall extend about 1m above landing for easy access and tying up purpose Do not place ladders against movable objects and maintain base at 1/4 unit of the working length of the ladder. Suspended scaffolds shall not be less than 500 mm wide and tied properly with ropes No loose planks shall be allowed Use PPE, like helmets, safety shoes, etc
	Failure of scaffolding material	Same as above	Inspect visually all scaffolding materials for stability and anchoring with permanent structures. Design scaffolding for max. load carrying capacity. Scaffolding planks shall not be less than 50X250 mm full thickness lumber or equivalent. These shall be cleated or secured and must extend over the end supports by at least 150mm and not more than 300mm Don't overload the scaffolds Do not splice short ladders to make a longer one. Vertical ladders shall not exceed 6m.
	Material can fall down	Persons working at lower level gets injured	Remove excess material and scrap immediately Carry the tools in a tool-kit bag only Provide safety nets

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CONSTRUCTION HAZARDS, THEIR EFFECTS & PREVENTIVE MEASURES (...Contd.)

ACTIVITY	TYPE OF HAZARD	EFFECT OF HAZARD	PREVENTIVE MEASURES
(N) STRUCTURAL WORKS	Personal negligence and danger of fall	Can cause injury or casualty	Do not take rest inside rooms built for welding machines or electrical distribution system. Avoid walking on beams at height Wear helmet with chin strap and full body harness while working at height. Use hand gloves and goggles during grinding operations Cover or mark the sharp and projected edges Do not stand within the operating radius of cranes
	Lifting/ slipping of material	Same as above	Do not stand under the lifted load Stack properly all the materials. Avoid slippage during handling Control longer pieces lifted up by cranes from both ends Remove loose materials from height Ensure tightening of all nuts & bolts
(O) PIPELINE WORKS	Erection/ lowering failure	Can cause injury	Do not stand under the lifted load Do not allow any person to come within the radii of the side boom handling pipes Check the load carrying capacity of the lifting tools & tackles Use safe Load Indicators Use appropriate PPEs
	Other	Same as above	Wear gum boots in marshy areas Allow only one person to perform signaling operations while lowering of pipes Provide night caps on pipes Provide end covers on pipes for stoppage of pigs while testing/ cleaning operations
(P) GRIT BLASTING	Pollution in neighboring area, hit by grits and high pressure air	Can cause personal injury	Ensure the blasting is done in enclosed shed. Keep safe distance while blasting operations. Wear positive pressure blast hood or helmet with view –window, ear-muff/plug, gloves, overall or leather coat /apron, rubber shoes.

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APPENDIX-F

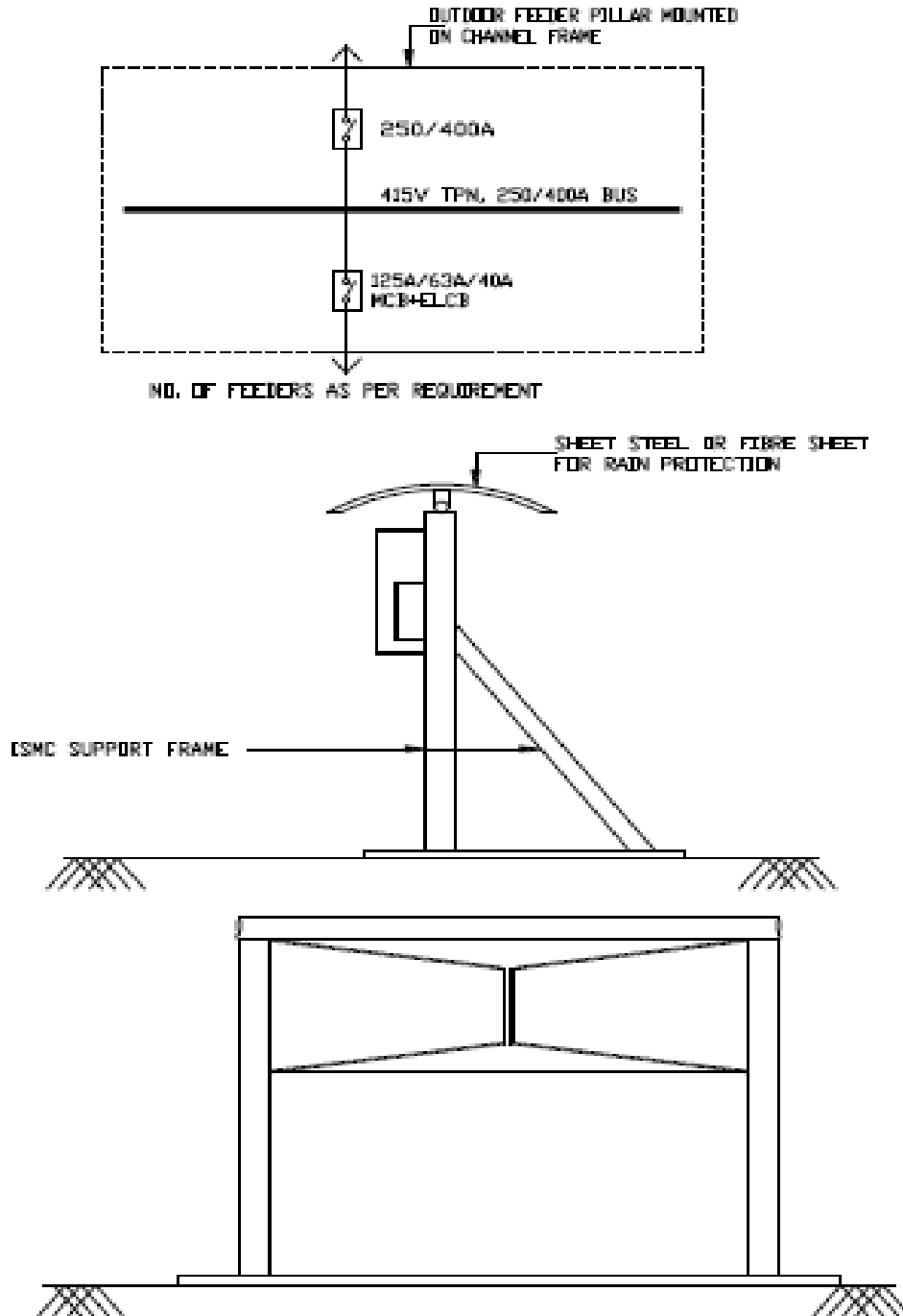
TRAINING SUBJECTS / TOPICS
(For contractors' personnel)

1. The Law & Safety – Statutory Requirement / Applicable statutes / Duties of employer / employee
2. Policy & Administration – Why HSE? / Duties & Responsibilities of Safety Personnel at project site / Effect of incentive on accident prevention
3. HSE & Supervision – Duties of Supervisor / HSE integrated supervision / Who should be held responsible for site accidents?
4. Safety Budget / Cost of Accidents – Direct costs / Indirect costs
5. Hazard Identification / Type of hazards / HIRAC
6. Behavioural Safety & Motivation
7. Housekeeping – Storage / Stacking / Handling of materials / Hydra handling
8. Occupational Health in Construction sector
9. Personal Protective Equipments – Respiratory & Non- respiratory
10. Electricity & Safety – ELCB / Fuse / Powered tools / Project illumination
11. Handling of Compressed Gas – Transportation / Storage / FBAs / Fire prevention
12. Machine Safety – Machine guarding / Maintenance
13. Transportation – Hazards & risks in transp. of materials / ODC consignments
14. Cranes & Other Lifting machinery – Legal requirements vis-à-vis essential safety requirements.
15. Communication – HSE Induction / TBTs / Safety Committee / Safety meeting / Safety propaganda / Publicity.
16. Excavation – Risks & Dangers / Safety measures
17. Working at Heights – Use of ladder / Work on roofs / Scaffolds / Double harness lanyards / Life-line / Fall arrester / Safety Nets / Floor openings
18. Hazards in Welding & important safety precautions
19. Gas Cutting – Hazards & safety measures
20. Fire prevention & fire protection

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APPENDIX - G

CONSTRUCTION POWER BOARD(typ)



NOTES:-

1. CONTRACTOR TO INSTALL TEMPORARY CONST. POWER BOARD AS SHOWN IN THE DRG. ITS LOCATION SHALL BE EASILY ACCESSABLE.
2. POWER DISTRIBUTION BOARD SHALL BE EARTHED AT TWO POINTS BY MINIMUM 40X5MM GI STRIP FROM THE AVILABLE GRID OR DIRECTLY CONNECTED TO TWO DIRECTLY DRIVEN EARTH ELECTRODES.
3. DISTRIBUTION BOARD SHALL BE FABRICATED BY USING 14MM CRCA SHEET STEEL WITH HINGED DOORS AND ALL COMPONENT MOUNTED IN IT.
4. ALL INCOMING AND OUTGOING CABLES SHALL HAVE BOTTOM ENTRY.

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APPENDIX-H

LIST OF PROCEDURES (MINIMUM) TO BE FORMING PART OF HSE PLAN:-

- A. HSE Management Procedures:
- X
 - X HSE Risk Management (including JSA/HIRA)
 - X HSE Legal Compliance and Other Requirements
 - X HSE Objectives & Performance
 - X HSE Training and Competence (including Induction)
 - X HSE Motivation & Award Scheme
 - X HSE Audits
 - X HSE Meetings
 - X HSE Sub Contractor Management
 - X HSE Emergency Management
 - X HSE Incidents Reporting and Management
 - X HSE Reports
 - X HSE Management System Review
 - X HSE Change Management
 - X HSE procedure for Behaviour based Safety
 - X First Aid & Management
 - Roles, Responsibility, accountabilities and Authorities
- B. Job procedures/Safe Operating procedures
- X
 - X Setting Up Site & Signage's
 - X Handling of Electrical Appliances
 - X Working at Height
 - X Confined Space Entry
 - X Permit to Work (including hot works)
 - X Housekeeping
 - X Lifting Operations
 - X Transportation of materials including Manual Handling
 - X Compressed Air Tools and Units
 - X Earthmoving Operations & excavation
 - X Scaffolding
 - X Fire Prevention/Protection
 - X Hazardous Substance handling & Storage
 - X Radiation Hazard
 - Personal Protective Equipment

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SAFETY WALK-THROUGH REPORT

(Name & signature of walk through performer to be inserted at the bottom of each page)

Project : _____ Report no. : _____
 Date : _____ Contractor : _____
 Inspection by : _____ Owner : _____
 Frequency : Monthly Job no. : _____

Note : Write 'NA' wherever the item is not applicable

SL. NO.	ITEM	Satisfactory / Yes	Non satisfactory/ No	Remarks	Action
1.	HOUSEKEEPING				
a)	Waste containers provided and used				
b)	Sanitary facilities adequate and Clean				
c)	Passageways and Walkways Clear				
d)	General neatness of working areas				
e)	Other				
2.	PERSONNEL PROTECTIVE EQUIPMENT				
a)	Goggles; Shields				
b)	Face protection				
	Hearing protection				
	Foot protection				
e)	Hand protection				
f)	Respiratory Masks etc.				
g)	Full body harness conforming to C ⁶ , EN 361				
h)	Hard hat (HDPE)				
i)	Other				
3.	EXCAVATIONS/OPENINGS				
a)	Openings properly covered or barricaded				
b)	Excavations shored				
c)	Excavations barricaded				
d)	Overnight lighting provided				
e)	Other				

Safety walk-through performer (Name & Signature).....

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SL. NO.	ITEM	Satisfactory / Yes	Non satisfactory/ No	Remarks	Action
4.	WELDING & GAS CUTTING				
a)	Gas cylinders chained upright				
b)	Cables and hoses not obstructing				
c)	Screens or shields used				
d)	Flammable materials protected				
e)	Live electrode bits contained properly				
f)	Fire extinguisher (s) accessible				
g)	Other				
5.	SCAFFOLDING & BARRICADING				
a)	Fully decked platforms				
b)	Guard and intermediate rails in place				
c)	Toe boards in place				
d)	Adequate shoring				
e)	Adequate access				
f)	Positive barricading for critical activities				
g)	Installation of warning signs				
h)	Other				
6.	LADDERS				
a)	Extension side rails 1 m above				
b)	Top of landing				
c)	Properly secured				
d)	Angle + 70 ⁰ from horizontal				
e)	Other				

Safety walk-through performer (Name & Signature).....

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SL. NO.	ITEM	Satisfactory / Yes	Non satisfactory /No	Remarks	Action
7.	HOISTS, CRANES AND DERRICKS				
a)	Condition of cables and sheaves OK				
b)	Condition of slings, chains, hooks and eyes O.K.				
c)	Inspection and maintenance log-books maintained				
d)	Outriggers used				
e)	Reverse horn installed / active / coupled with gear				
f)	Signs/barricades provided				
g)	Signals observed and understood				
h)	Qualified operators				
i)	Other				
8.	MACHINERY, TOOLS AND EQUIPMENT				
a)	Proper instruction				
b)	Safety devices				
c)	Proper cords				
d)	Inspection and maintenance				
e)	Other				
9.	VEHICLE AND TRAFFIC				
a)	Rules and regulations observed				
b)	Inspection and maintenance				
c)	Licensed drivers				
d)	Other				

Safety walk-through performer (Name & Signature).....

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SL. NO.	ITEM	Satisfactory / Yes	Non satisfactory /No	Remarks	Action
10.	TEMPORARY FACILITIES				
a)	Emergency instructions posted				
b)	Fire extinguishers provided				
c)	Fire-aid equipment available				
d)	Secured against storm damage				
e)	General neatness				
f)	In accordance with electrical requirements				
g)	Other				
11.	FIRE PREVENTION				
a)	Personnel trained & instructed to make use of facility				
b)	Fire extinguishers checked periodically & record maintained				
c)	No smoking in Prohibited areas.				
d)	Fire Hydrants not obstructed Clear				
e)	Other Regular fire drill conducted				
12.	ELECTRICAL				
a)	Use of 3-core armored cables everywhere				
b)	Usage of 'All insulated' or 'double-insulated' electrical tools				
c)	All electrical connection are routed through ELCB				
d)	Natural Earthing at the source of power (Main DB)				
e)	Continuity and tightness of earth conductor				
f)	Effective covering of junction boxes, panels and other energized wiring places				
g)	Ground fault circuit interrupters provided				
h)	Prevention of tripping hazards maintained				
f)	DCP extinguishers arranged & licensed electrician engaged at site				

Safety walk-through performer (Name & Signature).....

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SL. NO.	ITEM	Satisfactory / Yes	Non satisfactory /No	Remarks	Action
14.	HANDLING AND STORAGE OF MATERIALS				
a)	Safely stored or stacked				
b)	Passageways clear / free from obstructions				
c)	Fire fighting facility in place				
15.	FLAMMABLE GASES AND LIQUIDS				
a)	Containers clearly identified / protected from fire				
b)	Safe storage & transportation arrangement made				
c)	Fire extinguishers positioned nearby				
d)	Facilities kept away from electric spark, hot spatters & ignition source.				
16.	WORKING AT HEIGHT				
a)	Approved Erection plan and work permit in place				
b)	Safe access, Safe work platform & Safety nets provided				
c)	Life lines, Fall arrester, Full body harness and with double lanyards used;				
d)	Health Check record available for workers going up?				
e)	Protective handrails arranged around floor openings				
17.	CONFINED SPACE				
a)	Work Permit obtained from requisite authority				
b)	Test for toxic gas and sufficient availability of oxygen conducted & status				
c)	Supervisor present at site & at least one person outside the confined space for monitoring deputed				
d)	Availability of safe means of entry, exit and ventilation (register for entry & exit maintained)				
e)	Fire extinguisher and first-aid facility ensured				
f)	Lighting provision made by using 24V Lamp				
g)	Proper usage of PPEs ensured				
18.	RADIOGRAPHY				
a)	Proper storage and handling of source as per BARC/ AERB guidelines (authorized radiographer available)				
b)	Work permit obtained				

Safety walk-through performer (Name & Signature).....

**STANDARD SPECIFICATION FOR
HEALTH, SAFETY &
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AT CONSTRUCTION SITES**

FORMAT NO. : HSE-1 REV 0

(Sheet 6 of 6)

SL. NO.	ITEM	Satisfactory / Yes	Non satisfactory /No	Remarks	Action
c)	Cordoning of the area done				
d)	Use of appropriate PPE's ensured				
e)	HSE training to workers/supervisors imparted during the fortnight (indicate topic)				
f)	Minimum occupancy of workplace ensured				
19.	HEALTH CHECKS				
a)	All Workers medically examined and found be fit for working at heights (slinging, rigging, painting etc.) in confined space in excavation / trenching in shot blasting				
b)	Availability of First Aid box with contents				
c)	Proper sanitation at site, office and labour camps				
d)	Arrangement of medical facilities.				
e)	Measures for dealing with illness at site & labour camps.				
f)	Availability of Potable drinking water for workmen & staff.				
g)	Provision of crèches for children.				
h)	Stand by vehicle / ambulance available for evacuation of injured				
20.	ENVIRONMENT				
a)	Chemical and Other Effluents properly disposed				
b)	Cleaning liquid of pipes disposed off properly				
c)	Seawater used for hydro-testing disposed off as per agreed procedure				
d)	Lubricant Waste/Engine oils properly disposed				
e)	Waste from Canteen, offices, sanitation etc disposed properly				
f)	Disposal of surplus earth, stripping materials, Oily rags and combustible materials done properly				
g)	Green belt protection				

Safety walk-through performer (Name & Signature).....

**STANDARD SPECIFICATION FOR
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FORMAT NO. : HSE-2 REV 0

(Sheet 1 of 3)

ACCIDENT / INCIDENT REPORT

(To be submitted by Contractor after every Incident / Accident within 24 hours to PDIL/ Owner)

Report No.: _____ **Date:** _____

Project site: _____ **Name of work:** _____

Contractor's name: _____ Contractor's Job Engineer (name) _____

Non-disabling injury (Non-LTA)	Hospitalized but resumed duty before end of 48 hrs	
Disabling injury (other LTA)	Hospitalized & failed to resume duty within next 48 hrs	
Fatal (LTA):	Death / Expiry	
First Aid case (non LTA)	Resume duty after first aid	

Name of the injured: _____ Father's name of victim: _____

Sub Contractor's Name:

Gate Pass No.:..... Age: ____ Yrs. Victim's medical fitness exam. (Pre-empl.) date: - _____

Date & time of Accident / Incident: _____

Names of Witnesses: (1) _____ (2) _____ (3) _____

Profession of victim:

Bar bender		Carpenter		Meson	
Fitter		Helper		Gas cutter	
Grinder		Welder		Electrician	
Driver		Rigger		M/c.operator	
Engineer		Manager		Other/specify	

Qualification

No formal education		Non-Matriculate		Matriculate	
Graduate		Post- grad		Other/specify	

Job Experience

NIL		Less than 2 yrs		2-5 yrs	
5-10 yrs		11-15 yrs		15 years and above	

Location where the incident happened: _____

**STANDARD SPECIFICATION FOR
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ENVIRONMENT MANAGEMENT
AT CONSTRUCTION SITES**

FORMAT NO. : HSE-2 REV 0

(Sheet 2 of 3)

Activity / Works that was continuing during incident / accident: -

Excavation		Demolition		Concrete carrying	
Concrete pouring		Transportation of materials (manually)		Transportation of materials (mechanically)	
Work on or adjacent to water		Work at height (+2.0 mts)		Scaffold preparation	
Scaffold dismantling		Piling works		Welding	
Grinding		Gas-cutting		Pipe fit-ups & fabrication	
Structural fabrications		Machine works		Hydro-testing works	
Electrical works		Erection activities		Other/specify	

What exactly the victim was doing just before the incident / accident?

.....
.....

Nature of injury:

Bruise or Contusion		Abrasion (superficial wound)		Sprains or strains	
Cut or Laceration		Puncture or Open wound		Burn	
Inhalation of toxic or Poisonous fumes or gases		Absorption		Amputation	
Fracture		Other/specify			

Parts of body involved in incident / accident

Head		Face		Eyes	
Throat		Arm (above wrist)		Hand (including wrist)	
Fingers		Trunk (Abdomen / Back / Chest / Shoulder)		Throat	
Leg (above ankle)		Foot (incl. ankle)		Toes	
Multiple				Other/specify	

Accident type:

Struck against		Struck by		Fall from Elevation	
Fall on same level		caught in		caught under	
caught in between		Rubbed or abraded		Contact with (Electricity)	
Contact with (Temp./ extremes)		Contact with chemicals or oils		Vehicle accident	
Other/specify					

**STANDARD SPECIFICATION FOR
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ENVIRONMENT MANAGEMENT
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FORMAT NO. : HSE-2 REV 0

(Sheet 3 of 3)

Medical Aid provided: - (indicate specific aids / treatment etc.)-

.....
.....

Actions taken to prevent recurrence of similar incident / accident:

.....
.....
.....
.....
.....
.....
.....

Intimation to local authorities (Dist Collector / Local Police Station / ESI authority): Yes / No / NA.

If yes, to whom

Safety Officer
(Signature and Name)

Site Head / Resident Construction Manager
(Signature and Name)
Stamp of Contractor

To : Owner
: RCM/Site-in-charge PDIL (3 copies)
 ├─> Divisional Head (Constn) through RCM
 └─> Project Manager, PDIL, through RCM

**STANDARD SPECIFICATION FOR
HEALTH, SAFETY &
ENVIRONMENT MANAGEMENT
AT CONSTRUCTION SITES**

FORMAT NO. : HSE-3 REV 0

(Sheet 1 of 5)

**SUPPLEMENTARY INCIDENT / ACCIDENT INVESTIGATION REPORT
TICK THE APPROPRIATE ONE AS APPLICABLE (furnish within 72 hours)**

Supplementary to Incident / Accident Report No: _____ (Copy enclosed)

Report No.: _____ **Date:** _____

Project site: _____ **Name of work:** _____

Contractor's name: _____ Contractor's Job Engineer (name) _____

Non-disabling injury (Non-LTA)	Hospitalized but resumed duty before end of 48 hrs	
Disabling injury (other LTA)	Hospitalized & failed to resume duty within next 48 hrs	
Fatal (LTA):	Death / Expiry	
First Aid case (non LTA)	Resume duty after first aid	

Name of the injured: _____ Father's name of victim: _____

Sub Contractor's Name:

Gate Pass No.: Age: _____ Yrs. Victim's medical fitness exam. (Pre-empl.) date: - _____

Date & time of Accident / Incident: _____

Names of Witnesses: (1) _____ (2) _____ (3) _____

Profession of victim:

Bar bender		Carpenter		Meson	
Fitter		Helper		Gas cutter	
Grinder		Welder		Electrician	
Driver		Rigger		M/c.operator	
Engineer		Manager		Other/specify	

Qualification

No formal education		Non-Matriculate		Matriculate	
Graduate		Post- grad		Other/specify	

Job Experience

NIL		Less than 2 yrs		2-5 yrs	
5-10 yrs		11-15 yrs		15 years and above	

Location where the incident happened: _____

**STANDARD SPECIFICATION FOR
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FORMAT NO. : HSE-3 REV 0

(Sheet 2 of 5)

Activity / Works that was continuing during incident / accident: -

Excavation		Demolition		Concrete carrying	
Concrete pouring		Transportation of materials (manually)		Transportation of materials (mechanically)	
Work on or adjacent to water		Work at height (+2.0 mts)		Scaffold preparation	
Scaffold dismantling		Piling works		Welding	
Grinding		Gas-cutting		Pipe fit-ups & fabrication	
Structural fabrications		Machine works		Hydro-testing works	
Electrical works		Erection activities		Other/specify	

What exactly the victim was doing just before the incident / accident?

.....
.....

Particular of tools & tackles being used and condition of the same after incident/accident:

.....
.....

Description of Incident/Accident (How the incident was caused):

.....
.....

Nature of injury:

Bruise or Contusion		Abrasion (superficial wound)		Sprains or strains	
Cut or Laceration		Puncture or Open wound		Burn	
Inhalation of toxic or Poisonous fumes or gases		Absorption		Amputation	
Fracture		Other/specify			

Parts of body involved in incident / accident

Head		Face		Eyes	
Throat		Arm (above wrist)		Hand (including wrist)	
Fingers		Trunk (Abdomen / Back / Chest / Shoulder)		Throat	
Leg (above ankle)		Foot (incl. ankle)		Toes	
Multiple				Other/specify	

**STANDARD SPECIFICATION FOR
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FORMAT NO. : HSE-3 REV 0

(Sheet 3 of 5)

Accident type:

Struck against		Struck by		Fall from Elevation	
Fall on same level		caught in		caught under	
caught in between		Rubbed or abraded		Contact with (Electricity)	
Contact with (Temp./ extremes)		Contact with chemicals or oils		Vehicle accident	
Other/specify					

Name & Designation of person who provided First-Aid to the victim: -----

Name & Telephone number of Hospital where the victim was treated_____

Mode of transport used for transporting victim – Ambulance / Private car / Tempo / Truck / Others

How much time taken to shift the injured person to Hospital_____

In case of FATAL incident, indicate clearly the BOCW Registration No. of the victim /Company.....

Comments of Medical Practitioner, who treated / attended the victim/injured (attached / described here)_____

What actions are taken for investigation of the incident, please indicate clearly – (Video film / Photography / Measurements taken etc.....)

Immediate cause (Please tick the right applicable) –

Hazardous methods or procedures inadequately guarded		Poor housekeeping		Inadequate or improper PPE	
Environmental hazards (excess noise/ space constraint/ inadequate ventilation)		improper illumination/Moving on oval surface		Working on dangerous equipment	

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FORMAT NO. : HSE-3 REV 0

(Sheet 4 of 5)

Failure to secure		Horse-play		Failure to use PPE	
Inattention to surroundings		Improper use of hands & body-parts		By-passing safety devices	
Unsafe mixing or placement of tools & tackles		Bypassing standard procedures		Failure in communication	
Operating without authority		Improper use of equipment or tools & tackles		drug or alcoholic influence	
excessive haste		Others(specify)			

Basic cause

Over confidence		Impulsiveness		over-exertion	
Faulty judgement or poor understanding		Failing to keep attention constantly		Nervousness & Fear	
Fatigue		Defective vision		Ill health or sickness	
Slow reaction		Others(specify)			

Root cause

Inadequate Engg		Improper Design		Inadequate Planning & organization	
Inadequate knowledge		Inadequate skill		Inadequate training	
Inadequate supervision		Improper work procedure		Inadequate compliance with standard	
Substandard performance		Inadequate maintenance		Improper inspection	
Others(specify)					

Loss of man days and impact on site works, (if any) –

Remarks from Contractor's Safety Officer / Engineer –

Was the victim performing relevant tasks for which he was engaged /employed? Yes / No
 Was the Supervisor present on work-site during the incident? Yes / No
 Have the causes of incident rightly identified? Yes / No
 Cause of Accident was _____

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FORMAT NO. : HSE-3 REV 0

(Sheet 5 of 5)

Remedial measures recommended by **Safety Officer of Contractor** for avoiding similar incident in future

:

.....

.....

.....

.....

.....

.....

Intimation to local authorities (Dist Collector / Local Police Station / ESI authority): Yes / No / NA.

If yes, to whom

Safety Officer
(Signature and Name)

Site Head / Resident Construction Manager
(Signature and Name)
Stamp of Contractor

To : Owner
: RCM// Site-in-charge of PDIL (3 copies)
→ Divisional Head (Constn) through RCM
→ Project Manager PDIL, through RCM

**STANDARD SPECIFICATION FOR
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FORMAT NO. : HSE-4 REV 0

NEAR MISS INCIDENT/ DANGEROUS OCCURRENCE SUGGESTED PROFORMA

(to be submitted within 24 hours)

X

Near Miss : Human injury escaped & no damage to property, equipment

X or interruption to work.

Dangerous Occurrence: Damage to property, equipment or interruption of work, but not resulting in personal injury/illness, e.g. Fire incident, collapse of structure, crane failure, etc

Report No.: _____

Name of Site: _____

Date: _____

Name of work: _____

Contractor: _____

Incident reported by :

Date & Time of Incident :

Location :

Brief description of incident

Probable cause of incident

Suggested corrective action

Steps taken to avoid recurrence

Yes

No

To : Owner
: RCM/Site-in-charge PDIL (3 copies)

└─> Divisional Head (Constn) through RCM
└─> Project Manager PDIL, through RCM

**STANDARD SPECIFICATION FOR
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AT CONSTRUCTION SITES**

FORMAT NO. : HSE-5 REV 0
MONTHLY HEALTH, SAFETY & ENVIRONMENT (HSE) REPORT

(To be submitted by each Contractor)

Actual work start Date: _____ For the Month of: _____

Project: _____ Report No: _____

Name of the Contractor: _____ Status as on : _____

Name of Work : _____ Job No : _____

(Contractor in consultation with PDIL shall generate the reports through web based package(www.PDIL.co.in/contlse) only.

ITEM	UPTO PREVIOUS MONTH	THIS MONTH	CUMULATIVE
1) Average number of Staff & Workmen (average daily headcount, not man days)			
2) Man-hours worked			
3) Number of Induction programmes conducted			
4) Number of HSE meetings organized at site			
5) Number of HSE awareness programmes conducted at site			
6) Number of Tool Box Talks conducted			
7) Number of Lost Time Accidents (LTA)	Fatal		
	Other LTA		
8) Number of Loss Time Injuries (LTI)	Fatalities		
	Other LTI		
9) Number of Non-Loss Time Accidents			
10) Number of First Aid Cases			
11) Number of Near Miss Incidents			
12) No. of unsafe acts/ practices detected			
13) No. of disciplinary actions taken against staff/ workmen			
14) Man-days lost due to accidents			
15) LTA Free man-hours i.e. LTA free man-hours counted from the Last LTA (enter date:)			
16) Frequency Rate (No. of LTA per 2 lacs man-hours worked)			
17) Severity Rate (No. of man days lost per 2 lacs man-hours worked)			
18) Loss Time Injury Frequency (No. of LTI per 2 lacs man-hours worked)			
19) No. of activities for which Job Safety Analysis (JSA) completed			
20) No. of incentives/ awards given			
21) No. of occasions on which penalty imposed by PDIL/ Owner			
22) No. of Audits conducted			
23) No. of pending NCs in above Audits			
24) Compensation cases raised with Insurance			
25) Compensation cases resolved and paid to workmen			
26) Whether workmen compensation policy taken		Yes	No
27) Whether workmen compensation policy is valid		Yes	No
28) Whether workmen registered under ESI Act, as applicable		Yes	No
Remarks, if any			

Date:

Prepared by Safety Officer
(Signature and Name)

Approved by Site Head / Resident Construction Manager
(Signature and Name)

To : - OWNER

- RCM PDIL (2 copies)

**STANDARD SPECIFICATION FOR
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AT CONSTRUCTION SITES**

**FORMAT NO. : HSE-6 REV 0
PERMIT FOR WORKING AT HEIGHTS (ABOVE 2.0 METER)**

(In duplicate to be issued daily for site and for office)

Permit No..... Name of Main Contractor.....
 Name of work executing agency / sub agency / vendor:.....
 Date..... Exact Location of work.....
 Nature of workDuration of work (from) (to)
 Number of workers covered within this permit.....
 (List enclosed with name & gate pass numbers.)

Sl. No.	Items / Subjects	Status of compliance (Yes / No)	
1	Work areas / Equipments inspected		
2	Work area cordoned off		
3	Adequate lighting is provided		
4	Precautions against public traffic taken		
5	Concerned persons in & around have been alerted & cautioned		
6	Hazards / risks involved in routine / non-routine task assessed and control measures have been implemented at specific task		
7	ELCB provided for electrical connection & found working		
8	Ladder safely attached / fixed		
9	Scaffoldings are checked and TAGs are found used correctly		
10	Working platforms are provided and are found sound /safe for use		
11	Safe access & egress arrangements (e.g. ladders, fall arresters, life-lines etc.) are satisfactorily incorporated		
12	a. Openings on platform / floors are effectively cordoned / covered		
	b. Safety Nets are provided wherever required		
13	Use of following safety gadgets by people working at area under this permit, is checked and found satisfactory -		
	Safety helmet		
	Safety harness (full body) with double lanyard		
	Safety Shoes		
	Safety gloves		
14	Housekeeping of work area found satisfactorily tidy / clean & clear		
15	Adequate measures have been taken for works being continued at the ground level, when simultaneous works are permitted overhead at that very location.		
16	Materials are not thrown from heights on to ground		
17	Medical examination of workers are made & found satisfactory		
18	Responsible job engineer / supervisor found physically present at work spot for overall administration of work as well as safety of people.		

Above items have been checked & compliance has been found in place. Hence work is permitted to start / continue at the above-mentioned location. Work shall not start till identified lapses are rectified.

Additional Precautions, if any

Work Permit issued by
Contractor Engineer/RCM

Verification By
Contractor Safety Officer

AT THE END OF THE DAY/WORK:

All works at height are completed & workmen have returned safely from work location at (time)..... (date).....

(Sig. Contractor Engineer)

**STANDARD SPECIFICATION FOR
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AT CONSTRUCTION SITES**

FORMAT NO. : HSE-7 REV 0

CONFINED SPACE ENTRY PERMIT

Project site _____ Sr.No. _____
 Name of the work _____ Date _____
 Name of Contractor _____ Nature of work _____
 Exact location of work _____

Safety Requirements: POSITIVE ISOLATION OF THE VESSEL IS MANDATORY

(A) Has the equipment been ?

Y	NR	Y	NR	Y	NR			
<input type="checkbox"/>	<input type="checkbox"/>	Isolated from	<input type="checkbox"/>	<input type="checkbox"/>	water flushed &/or	<input type="checkbox"/>	<input type="checkbox"/>	radiation sources
<input type="checkbox"/>	<input type="checkbox"/>	power/steam/air	<input type="checkbox"/>	<input type="checkbox"/>	steamed	<input type="checkbox"/>	<input type="checkbox"/>	removed
<input type="checkbox"/>	<input type="checkbox"/>	isolated from liquid or	<input type="checkbox"/>	<input type="checkbox"/>	Man ways open &	<input type="checkbox"/>	<input type="checkbox"/>	proper lighting
<input type="checkbox"/>	<input type="checkbox"/>	gases	<input type="checkbox"/>	<input type="checkbox"/>	ventilated	<input type="checkbox"/>	<input type="checkbox"/>	provided
<input type="checkbox"/>	<input type="checkbox"/>	depressurized &/or	<input type="checkbox"/>	<input type="checkbox"/>	cont. inert gas flow	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	drained	<input type="checkbox"/>	<input type="checkbox"/>	adequately cooled	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	blanked/ blinded/	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	disconnected						

(B) Expected Residual Hazards:

<input type="checkbox"/>	<input type="checkbox"/>	lack of O ₂	<input type="checkbox"/>	<input type="checkbox"/>	combustible gas/ liquid	<input type="checkbox"/>	<input type="checkbox"/>	H ₂ S / toxic gases
<input type="checkbox"/>	<input type="checkbox"/>	corrosive chemicals	<input type="checkbox"/>	<input type="checkbox"/>	pyrophoric iron / scales	<input type="checkbox"/>	<input type="checkbox"/>	electricity / static
<input type="checkbox"/>	<input type="checkbox"/>	heat/ steam / frost	<input type="checkbox"/>	<input type="checkbox"/>	high humidity	<input type="checkbox"/>	<input type="checkbox"/>	ionizing radiation
<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	

(C) Protection Measures:

<input type="checkbox"/>	<input type="checkbox"/>	gloves	<input type="checkbox"/>	<input type="checkbox"/>	ear plug / muff	<input type="checkbox"/>	<input type="checkbox"/>	goggles / face shield
<input type="checkbox"/>	<input type="checkbox"/>	protective clothing	<input type="checkbox"/>	<input type="checkbox"/>	dust / gas / air line mask	<input type="checkbox"/>	<input type="checkbox"/>	personal gas alarm
<input type="checkbox"/>	<input type="checkbox"/>	grounded air duct/blower /AC	<input type="checkbox"/>	<input type="checkbox"/>	attendant with SCBA/air mask	<input type="checkbox"/>	<input type="checkbox"/>	rescue equipment/team
<input type="checkbox"/>	<input type="checkbox"/>	Fire fighting arrangements	<input type="checkbox"/>	<input type="checkbox"/>	safety harness & lifeline	<input type="checkbox"/>	<input type="checkbox"/>	communication equipment
<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	

Authorization / Renewal (It is safe to enter the confined space)

	No. of persons allowed	Name of persons allowed	Signature		Time		Signature
			Contractor's Supervisor	Contractor's Safety Officer	From	To	Workman

Permit Closure :

- (A) Entry was closed stopped will continue on ...
- (B) Site left in a safe condition Housekeeping done
- (C) Multilock removed key transferred
- Ensured all men have come out Man-ways barricaded

Remarks, if any:

**STANDARD SPECIFICATION FOR
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AT CONSTRUCTION SITES**

FORMAT NO. : HSE-8 REV 0

RADIATION WORK PERMIT

Project : Sr.No. :
Name of the work : Date :
Name of site contractor : Job No.:

Location of work :

Source strength :

Cordoned distance (m) :

Name of Radiography agency : Approved by Owner/PDIL

No. of workers engaged :
(List enclosed with name & gate pass numbers.)

The following items have been checked & compliance shall be ensured during currency of the permit:

S. No.	Item description	Done
	Safety regulations as per BARC/AERB ensured while source in use/in transit & during storage	<input type="checkbox"/>
	Area cordoned off / safe working platform provided	<input type="checkbox"/>
	Lighting arrangements for working during nights ensured	<input type="checkbox"/>
	Warning signs/ flash lights installed	<input type="checkbox"/>
	Cold work permit taken (if applicable)	<input type="checkbox"/>
	PPEs like film badges, dosimeters used	<input type="checkbox"/>

Additional precautions, if any _____

(Radiography Agency's BARC/AERB authorized Supervisor)

Permission is granted.

Permit is valid from _____ AM/PM _____ Date to _____ AM/PM _____
Date

(Signature of permit issuing authority of site contractor)

Name : Designation: Date:

Permit renewal:

Permit extended up to		Additional precautions required, if any	Sign of issuing authority with date (of site contractor)
Date	Time		

Work completed/ stopped/ area cleared at _____ Hrs of Date _____

(Sign. of permit issuing authority)

Name & Signature of site contractor:

**STANDARD SPECIFICATION FOR
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AT CONSTRUCTION SITES**

FORMAT NO. : HSE-9 REV 0
DEMOLISHING/DISMANTLING WORK PERMIT

Project : Sr.No. :
Name of the work : Date :
Name of contractor : Job No. :

Name of sub-contractor : No. of workers to be engaged:
(List enclosed with name & gate pass numbers.)

Line No./ Equipment No./ Structure to be dismantled :

Location details of dismantling/ demolition with sketch : (clearly indicate the area)

The following items have been checked & compliance shall be ensured during currency of the permit:

S. No.	Item description	Done	Not Applicable
	Services like power, gas supply, water, etc. disconnected	<input type="checkbox"/>	<input type="checkbox"/>
	Dismantling/ Demolishing method reviewed & approved	<input type="checkbox"/>	<input type="checkbox"/>
	Usage of appropriate PPEs ensured	<input type="checkbox"/>	<input type="checkbox"/>
	Precautions taken for neighbouring structures	<input type="checkbox"/>	<input type="checkbox"/>
	First-Aid arrangements made	<input type="checkbox"/>	<input type="checkbox"/>
	Fire fighting arrangements ensured	<input type="checkbox"/>	<input type="checkbox"/>
	Precautions taken for blasting	<input type="checkbox"/>	<input type="checkbox"/>

(Contractor's Supervisor)

(Contractor's Safety Officer)

Permission is granted.

(Permit issuing authority)

Name :

Date :

Completion report :

Dismantling/ Demolishing is completed on _____ Date at _____ Hrs.

Materials/ debris transported to identified location Tagging completed (as applicable)

Services like power, gas supply, water, etc. restored

(Permit issuing authority)

CONTRACTOR'S NAME

**STANDARD SPECIFICATION FOR
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AT CONSTRUCTION SITES**

FORMAT NO. : HSE-10 REV 0

DAILY SAFETY CHECKLIST

(To make use of before start of day's work)

Project : Sr.No. :
Name of the work : Date :
Name of contractor : Job No. :

Description of Job decided to perform : -

✱

Use of PPE / Safety Gadgets

Sl. No	PPEs	Compliance (Yes / No)	Sl. No	PPEs	Compliance (Yes / No)
1	Safety Helmets		6	Face Shield	
2	Safety Shoes		7	Full body harness	
3	Hand Gloves		8	Fall Arrest System	
4	Dust Musk		9	Safety net	
5	Safety Goggles		10	Horizontal life-line made of steel wire, (dia not less than 8.0 mm.)	

(Serial No. 1 & 2 are compulsory for everyone. Specify & ensure use of other safety gadgets as required for the job)

X

Identify following important unsafe conditions: -

SL No	Conditions	Yes / No
1	Access to work site / emergency escape clear	
2	Soil / Loose earth kept away from excavated pit / slope / ladder provided	
3	Electrical wire / welding lead lying entangled on ground / welding m/c. booth accessible	
4	Elevated work platform / open ends are protected	
5	Ground area cordoned off before lifting works or erection at height / ground area checked & cordoned-off before start of height works	
6	Structural members / erected pipes / wooden boards/pieces etc. are safely anchored at heights and are not likely to fall down on people when working beneath	
7	Rope ladders tied-up on tall steel structures, long before are removed to get rid of their use	
✱	Any Other	

Indicate actions taken, if status of any of the above items is found "No"

X

Specific Safety guidelines / precautions, if any (communicated thro' TBT)

X

Above conditions and PPE compliances are checked by undersigned and correct status are indicated after verification

Inspected by
Contractor Engineer

Verification By
Contractor Safety Officer

**STANDARD SPECIFICATION FOR
HEALTH, SAFETY &
ENVIRONMENT MANAGEMENT
AT CONSTRUCTION SITES**

FORMAT NO. : HSE-11 REV 0

(Sheet 1 of 2)

HOUSEKEEPING ASSESSMENT & COMPLIANCE

Project : Sr.No. :
Name of the work : Date :
Name of contractor : Job No. :
Name of contractor : Fortnightly

Sl No.	Subjects of Review	Satisfactory/ Yes	Non satisfactory/No	Remarks	Action
1.	Cleanliness at the Main entry / access of site				
2.	Ground condition / floor areas free from water-logging / oil spillage				
3.	Ground & elevated floors free from rubbish / wastes / accumulated debris / scraps.				
4.	Manholes / openings are covered / fenced				
5.	Trenches are barricaded / walkways are in place				
6.	Drains are cleaned / not choked / not occupied by dumped materials				
7.	Sufficient CAUTION boards / instructions displayed				
8.	Construction machinery are maintained & parked in orderly manner.				
9.	Movement of site people are not obstructed because of dumping / storing of construction materials				
10.	Access / egress to Electrical Distribution Boards / Panels clear from wires / cables / earth-strips etc.				
11.	Electrical panel rooms / sheds / MCC / Control rooms / Substations etc. are clean & tidy and not used for storing dress / clothes, tiffin-box or bicycles.				
12.	Passage behind Elec. panels are free for access				
13.	Fire extinguishers / fire-buckets are accessible without any difficulty.				
14.	Stair-steps, platforms & landings are clear & tidy				
15.	Sheds / rooms & work areas have got sufficient illumination as well as ventilation				
16.	Cables / Wires / welding leads are routed / hanged appropriately & are not creating unsafe condition.				
17.	Stacking / storing of insulation materials or their packing.				
18.	Removal or cleanliness of left-over sand, concrete, brick-bats, insulation-materials, excess earth, wastes etc.				
19.	Storing / stacking of sand, metal chips, re-bars, steel pipes, valves, fittings etc.				
20.	One escape route at ground & minimum two escape routes at elevation available.				

**STANDARD SPECIFICATION FOR
HEALTH, SAFETY &
ENVIRONMENT MANAGEMENT
AT CONSTRUCTION SITES**

FORMAT NO. : HSE-11 REV 0

(Sheet 2 of 2)

Sl No.	Subjects of Review	Satisfactory/ Yes	Non satisfactory/No	Remarks	Action
21.	Captions / Posters / Slogans on various safety instructions are displayed legibly in local language				
22.	Cable trenches are water-free or regular arrangement for taking out accumulated water exists.				
23.	Windows of rooms / offices are regularly cleaned				
24.	Facilities for cycle sheds, drinking water, washing, rest-rooms etc. are maintained in tidy manner.				
25.	Toilet, Urinals, Canteen / kitchen / pantry etc. are maintained & free from obnoxious smell.				
26.	Construction tools / tackles are stored systematically - the items are tagged / tested / certified by competent third party.				
27.	Sufficient numbers of Dust-bins / Waste-bins found at site and are regularly emptied.				

Additional remarks, if any -

.....

Inspected by
Contractor Engineer

Verification By
Contractor Safety Officer

**STANDARD SPECIFICATION FOR
HEALTH, SAFETY &
ENVIRONMENT MANAGEMENT
AT CONSTRUCTION SITES**

FORMAT NO. : HSE-12 REV 0

INSPECTION OF TEMPORARY ELECTRICAL BOOTH / INSTALLATION

Project : Sr.No. :
Name of the work : Date :
Name of contractor : Job No. :
Sub Station No:/Booth No Location:

SL NO	SUBJECTS	OBSERVATION (YES /NO)	ACTION TAKEN
1	Switchboards installed properly are in order and protected from rain & water-logging.		
2	Adequate illumination provided for switchboard operation during night hours & the lamps are protected from direct human contact.		
3	Voltage ratings, DANGER signs, Shock-Treatment-Chart displayed in the installation / booth		
4	Fire extinguisher (DCP or CO 2) & Sand Bucket kept in close vicinity of Switchboards		
5	Valid License & Competent Electrician / Wireman available & name/ license no. displayed at booth / installation.		
6	General housekeeping in & around booth / installation found in order.		
7	Cable-route-markers for U/G cables provided.		
8	Monthly inspection report of Electrical hand tools available in booth / installation.		
9	Insulated Mat provided in front of Elec. Panels.		
10	Rubber hand gloves available/ used by Electricians		
11	Availability of CAUTION boards for shutdown & / or repairing works.		
12	All incoming & outgoing feeders have proper MCCB / HRC fuses / Switches.		
13	Switchboards "earthed" at two distinctly isolated locations.		
14	Switchboards have adequate operating space at the front face & at the rear face too.		
15	All connections provided through 30mA ELCB.		
16	Testing records of all ELCBs available at site		
17	Only industrial type plugs & sockets are used.		
18	Temporary connections are 3-core double insulated & free from cuts & joints and 3 rd core is earthed at both ends		
19	Socket boards are properly mounted on stand & protected from water ingress.		
20	Electrical equipments operating above 250V have two earthing / double earthing.		
21	All incoming / outgoing cables are properly glanded & terminated with "lugs".		
22	Switch-boards are of industrial variety / type.		
23	Sketch for installation / connection (SLD) made & pasted & other safety labels/display boards		
24	Labeling of incoming / outgoing feeders made.		
25	All hand lamps are protected from direct contact.		
26	All electrical cable / joints are in safe condition		

Inspected by
Contractor Engineer

Verification By
Contractor Safety Officer

**STANDARD SPECIFICATION FOR
HEALTH, SAFETY &
ENVIRONMENT MANAGEMENT
AT CONSTRUCTION SITES**

FORMAT NO. : HSE-13 REV 0

(Sheet 1 of 2)

INSPECTION FOR SCAFFOLDING

Project : Sr.No. :
Name of the work : Date :
Name of contractor : Job No. :

Sl. No	Description	Yes	No	N.A	Actions taken
1	Whether work permit is obtained to take up work at height above 1.5 Mts?				
2	Whether atmospheric condition is "stormy" or "raining" and works at heights have been permitted?				
3	Whether steel pipes scaffoldings are used for units /off-site areas?				
4	Whether scaffolding has been erected on rigid/firm/leveled surfaces / ground? Whether "foot-seals" or "base-plates" are used beneath the up-rights (vertical steel pipes)				
5	Whether scaffold construction is as per IS specification with toe-board and hand-rails (top-rail as well as mid-rail)?				
6	Whether distance between two successive up-rights are less than 2.5 Mts (height of scaffold & load carrying capacity governs the distance between two uprights)				
7	Whether all uprights are extended at least 900 mm above the top most working platform (to enable fitting of handrails)?				
8	Whether vertical distance of two successive ledgers is satisfactory? (varying between 1.3 Mts. To 2.1 Mts)				
9	Whether the peripheral areas of working at height are cordoned-off? (for avoiding accident to people arising out of dropped / deflected materials)				
10	Whether platform is provided? Is it safely approachable?				
11	Whether end of scaffold platform / board are extended beyond transoms? (125mm to 150 mm)				
12	Whether CE / IS approved quality and worthy conditioned full-body safety harness (with double lanyard & karabiners) are used while working at heights?				
13	Whether life-line of safety harness is anchored to an independent secured support capable of withstanding load of a falling person?				
14	Whether the area around the scaffold is cordoned off to prohibit the entry of unauthorized person / vehicle?				
15	Whether clamps used are of good condition, of adequate strength and free from defects?				
16	Whether ladder is placed at secured and leveled surface?				
17	Whether water-pass and oil-spills are avoided around the scaffold structure?				
18	Whether ladder is extended 1.5mts. above the landing point at height?				
19	Whether more than one access/egress provided to the scaffold?				
20	Whether ladder used are of adequate length and overlapping of short ladders avoided?				
21	Whether metallic ladders are placed much away from near-by electrical transmission line?				
22	Whether rungs of ladder are inspected and found in good order?				
23	Whether fall-arresters provided on both the access/egress routes?				
24	Whether diagonal (cross) bracings are provided at regular interval on the scaffold?				
25	Whether working platform on the scaffold has been made free from "jolt" or "gap"?				
26	Whether tools or materials are removed after completion of the day's job at heights?				
27	Whether a valid Permit for Work (PFW) is obtained before taking up work over asbestos or fragile roof?				
28	Whether sufficient precaution is taken while working on fragile roof?				

**STANDARD SPECIFICATION FOR
HEALTH, SAFETY &
ENVIRONMENT MANAGEMENT
AT CONSTRUCTION SITES**

FORMAT NO. : HSE-14 REV 0

(sheet 1 of 2)

PERMIT FOR ERECTION / MODIFICATION & DISMANTLING OF SCAFFOLDING

Project : Sr.No. :
 Name of the work : Date :
 Name of contractor : Job No. :
 Nature of activities : Duration: From.....To.....

SL. No.	SUBJECTS / ITEMS	DONE	NOT DONE	REMARKS
1	Specific task of Erection / Modification / Dismantling of scaffolds, identified & TAGGED accordingly (before as well as after carrying-out jobs).			
2	People engaged in doing the job are identified & are certified by Job Engineer of Main Contractor as experienced / trained.			Names to be noted
3	Concerned persons are alerted by the Job Engineer of Main Contractor in connection with possible hazards & what the workmen MUST do / MUST not do.			
4	Verification by Job Engineer of Main Contractor made for confirming that all persons permitted to carry-out the jobs are making use of Helmet, Safety Shoes, Goggles, Gloves & Double lanyard safety harness and other relevant PPEs.			
5	Area of work is effectively cordoned-off / barricaded / illuminated.			
6	For taking-up / lowering down Scaffolding members / clamps / couplings etc. appropriate ropes / pulleys/ chains etc. have been arranged for use (not to throw any item) & the same have been verified as "fit for purpose".			
7	Items / members of scaffold, being lowered are removed from the area & stacked correctly.			
8	Ropes, chains, pulley blocks etc. being used for lifting or lowering scaffold items, are inspected by the Job Engineer & their certifications as well as physical conditions have been found O.K, before signing this PERMIT.			
9	Safety Net / Life-line / Fall Arresters etc. are arranged in position and Job Engineer has found working conditions favourable for activities to start.			
10	Scaffold erection or dismantling tasks are being supervised by Experienced Engineer / Competent person.			
11	Only competent & experienced people have been selected / engaged in Scaffolding erection, modification or dismantling tasks.			
12	Adequate & effective actions for traffic and movement of people around the cordoned-off area taken to avoid inadvertent incident			
13	Working platforms are protected with handrails & toe-boards.			
14	Access & Exit (for reach & escape) are safe for use by people.			
15	Tools, tackles to be used for above jobs are verified by job Engineers of Main contractor as genuinely good and tied-up at height (to prevent their fall).			
16	Site important Telephone Nos. are made known to everyone			
17	SOP (Safe Operating Procedure) for the specific task is made & followed too.			
18	Emergency vehicle has been arranged at work locations.			

- X
- X This permit for work shall be available at specific work location all the time.
- X After completion of work, permit shall be returned to safety cell of main contractor, without fail.
- X This Permit shall be issued maximum upto (Monday to Sunday).
- X Additional Precautions, if any
- X

ACCORD OF PERMISSION (to be ticked) - YES () / NO ()

Inspected by
Contractor Engineer

Verification By
Contractor Safety Officer]

FORMAT NO. : HSE-15 REV 0

PERMIT FOR HEAVY LIFT/CRITICAL ERECTION

Project :	Sr.No. :
Name of the work :	Date :
Name of contractor :	Job No. :
Nature of activities :	Duration: From.....To.....
Location of work :	Name /Type of crane :
Equipment/Structure to be erected:	Wt. of equipment/ structure to be erected :

SL. NO.	Description of Item	COMPLIANCE STATUS			Remarks
		Yes	No	Not applicable	
1)	Is the crane type suitable for lift or as per erection procedure?				
2)	Is the crane have the correct number of counterweights fitted?				
3)	Availability of Load Certification of crane from authorized agency.				
4)	Is the load chart of crane available in crane cabin/or with Crane operator?				
5)	Is the device to check the Wind speed in crane is working? Is the safety features in crane are working?				
6)	Availability of Load certification of slings and other accessories from authorized agency				
7)	Availability of Licensee/certificate for crane operator from authorized agency.				
8)	Availability of approved JSA for the subject activities.				
9)	Availability of approved erection/rigging procedures.				
10)	Availability of temporary gratings/ platforms for critical lifting(as applicable)				
11)	Tool Box conducted before erection?				
12)	Has the area been cordoned off?				
13)	Are the authorized persons during erection are identified?				
14)	Does each person identified for erection understand their roles and responsibilities?				
15)	Is the ground on which crane will rest or outrigger support are correct?				
16)	Is hard stand requirement (if any) complied?				
17)	Is the communication system (viz walkie talkies,etc are working properly?				
18)	If more than one crane is lifting the load, is an Intermediate rigger will supervise the lift?				
19)	If there is other obstruction within the operating radius of the crane, have correct precautions been taken to prevent collision?				
20)	All the persons are wearing the requisite PPE?				

Inspected & Issued by
Contractor Engineer/RCM

Verification By
Contractor Safety Officer

FORMAT NO. : HSE-16 REV 0

PERMIT FOR ENERGY ISOLATION & DE-ISOLATION

Project : Sr.No. :
 Name of the work : Date :
 Name of contractor : Job No. :

X ENERGY ISOLATION PERMIT	
X Clearance required from:.....HrsDate	ToHrsDate
X Name of equipment/ energy source etc	
X Nature of job to be done:	
Area.....Location:.....	

<p>PERMIT VALIDATION</p> <p>I hereby authorize thepersonnel(performer) to isolate the above equipment/energy source from all sources of power and handover the equipment/energy source for maintenance/repair.</p> <p>Issuing authority Area –Incharge/RCM Signature: _____ Date: _____ Name: _____</p>	<p>PERFORMING AUTHORITY</p> <p>The work and precautions will be carried out under my overall responsibility.(Testing/execution engineer)</p> <p>Signature: _____ Date: _____ Name: _____</p>
---	--

<p>SAFETY PRECAUTIONS FOR CLEARANCE</p> <ol style="list-style-type: none"> 1. Notify workers of intent to de- energize <input type="checkbox"/> 2. Obtain lock,tag or locking/tagging devices <input type="checkbox"/> 3. Shut down ,de energize, dissipate any residual energies. <input type="checkbox"/> 4. Apply lock ,tag and locking and/or tagging devices <input type="checkbox"/> 5. *Any other job specific precautions <input type="checkbox"/> 6. Verify effectiveness of lockout by attempting to restart. <input type="checkbox"/> 7. Proper PPE is ensured <input type="checkbox"/> <p>I certify that the energy source mentioned above is isolated from all sources and is safe to start the work.</p> <p>Tag No:..... Lock No:.....</p> <p>Issuing authority Area –Incharge/RCM Signature: _____ Date: _____ Name: _____ (*to be included by contractor in consultation with PDIL/owner)</p>	<p>NORMALISING AFTER CLEARANCE</p> <ol style="list-style-type: none"> 1. Notify workers of intent to re- energize <input type="checkbox"/> 2. Conduct visual inspection to confirm that the danger zone is clear of workers <input type="checkbox"/> 3. Conduct visual inspection to confirm that tools ,equipments danger zone is clear of workers <input type="checkbox"/> 4. Reposition the safety devices(interlocks, valves, guards, covers ,sensors, as applicable, etc) <input type="checkbox"/> 5. *Any other job specific normalizing details <input type="checkbox"/> 6. Remove lock, tag and locking and/or tagging devices. <input type="checkbox"/> 7. Re energize. <input type="checkbox"/> 8. Confirm system is operating properly& safely <p>I certify that the energy source mentioned above is isolated from all sources and is safe to start the work.</p> <p>Tag No:..... Lock No:.....</p> <p>Issuing authority Area –Incharge/RCM Signature: _____ Date: _____ Name: _____ (*to be included by contractor in consultation with PDIL/owner)</p>
---	---

ENERGY DE-ISOLATION PERMIT	
<p>PERMIT VALIDATION</p> <p>I hereby authorize thepersonnel(performer) to de- isolate the above equipment/energy source from all sources of power and handover the equipment/energy source for normal operation..</p> <p>Issuing authority Area –Incharge/RCM Signature: _____ Date: _____ Name: _____</p>	<p>PERFORMING AUTHORITY</p> <p>I herby certify that the equipment/energy source mentioned above has been de-isolated and is ready for normal operation.(Testing/execution engineer)</p> <p>Signature: _____ Date: _____ Name: _____</p> <p align="center">Countersigned by Issuing authority</p>

FORMAT NO. : HSE-17 REV 0

PERMIT FOR EXCAVATION (depth 2m and above)

(Sheet 1 of 2)

Project :	Sr.No. :
Name of the work :	Date :
Name of contractor :	Job No. :
Job Description :	Location:
Size of excavation :	

SL. NO.	Description of Item	COMPLIANCE STATUS			Remarks
		Yes	No	Not applicable	
1)	Suitable and sufficient risk assessments and method statements has been carried to ensure that the work shall be undertaken in accordance with specification and standard.				
2)	Are plans/details of underground services available and the same has been reviewed?				
3)	Has survey done to locate the services/obstacles, etc.				
4)	Has the live services (electrical, water line, air line, telephone line etc) has been disabled for carrying out the job.				
5)	Is adequate barriers/fences to protect the excavation are in place?				
6)	Is Adequate warning signs are in place?				
7)	Is Assessment of ground conditions done and remedial action (if any) taken?				
8)	Safe access / egress (e.g. ramp / steps / ladders etc.) provided for site workmen & supervisors.				
9)	Is the excavation work being undertaken in proximity of structure, etc ? If Yes, it's effect is considered?				
10)	Availability of competent person for supervising the excavation work?				
11)	Adequate safe arrangement to prevent collapse of edges (e.g. shoring / strutting / benching / sloping etc.) made at site.				
12)	Hard barricades (at least 1.0M away from edge & for excavation near site access roads) with warning signs/caution boards are provided				
13)	Accumulation / passage-ways of water at periphery of excavation / trench stopped/ restricted.				
14)	Is the equipment being used for excavation has been checked for adequacy and is in good working condition having all the safety features?				
15)	Age & fitness of workmen ensured by medical test before engagement in job ?				
16)	Arrangement of Monitoring of possible oxygen deficiency or obnoxious gases done & action taken?				

PERMIT GRANTED - Yes / No

(List enclosed with name & gate pass numbers.)

Name & Signature of Site Engr
Contractor (Initiator)

Name & Signature of Safety Officer
Contractor (Issuing authority)

FORMAT NO. : HSE-17 REV 0

PERMIT FOR EXCAVATION

(Sheet 2 of 2)

NOTES: -

1. Slopes or benches for excavation beyond 2.0M depth shall be designed & approved by Contractor's site head.
2. Excavated earth to be kept at least 1.5M away from edges
3. Safety helmets, Safety shoes or gum-boots, gloves, goggles, Face shield, Safety Harness shall be essential PPEs.
4. Permit shall be made in **duplicate** and original shall be available at site of work.
5. Permit shall be issued for maximum **one week** only (Monday to Sunday)
6. After completion of works, permit shall be closed & preserved for record purpose

GRANT OF PERMIT AND EXTENSIONS

Sl. No.	Validity period From ____ To ____	Working Time From ____ To ____	Initiator (site Engr. of Main Contractor)	Issuing authority (Safety Officer of Main Contractor)	Review by PDIL / Owner (Remarks with date)
1.					
2.					
3.					
4.					
5.					
6.					
7.					

Additional safety instructions if any: -

- 1.
- 2.
- 3.

SECTION-VI

TECHNICAL SPECIFICATION

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PART-1
PROJECT TECHNICAL SPECIFICATION
(220 kV GIS Switching Station)

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INTRODUCTION

GENERAL:

- Talcher Fertilizer Limited (TFL) is a Public Company incorporated in 2015. It is classified as Non- Govt. Company and is registered at Registrar of Companies at Cuttack. Considering the increase in demand for fertilizers in the Country, TFL intends setting up fertilizer project for production of 2200MTPD Ammonia and 3850MTPD.
- OPTCL approved for connectivity at 220kV tap off on the 220kV TTPS – Rengali line. Talcher Fertilizer Limited (TFL), located in Angul at Odisha, for an expected energy requirement of around 90MW.
- TFL will establish 220kV GIS Switching Substation within TFL boundary with LILO Arrangement. Station will also have 220/33kV 20MVA Power Transformer for local requirement. The 220kv Transmission line and the GIS Substation having 220kV GIS and 33kV Outdoor Switchyard and associated control system will be operated and maintained by OPTCL.

PROJECT DESCRIPTION:

220kV GIS SUBSTATION:

Description	No of Feeders
220kV (Double main bus)	
220kV Line bays from TTPS-Rengali (LILO)	2 nos
220kV Line bays to MRSS Station	2 nos
220/33kV 20MVA Power Transformer bays with Equipments	1 no
220kV Bus coupler bay	1 no
220kV Bus PT bays	2 nos
Provision and space for 220kV Future bays	2 nos

33kV OUTDOOR SWITCHYARD:-

Description	No of Feeders
33kV (Single main bus with Transfer bus)	
33kV Incomer Transformer Bay	1 no
33kV Transfer Bus coupler bay	1 no
TFL Feeder bays	2 nos
Station Transformer bays	2 nos
Provision and space for 33kV Future Bays	2 nos

- 220KV DC Transmission line of approx. 5.0K M from TTPS - Rengali tap off point.
- 220kV D/C U/G Cable from proposed GIS Substation to TFL receiving Substation.

PROJECT SUMMARY:

- The Specification includes Design, Engineering Manufacture, Fabrication, Testing at Manufacturers Works of Equipment and Materials, Loading, Transportation and Delivery, Unloading at Site, Storage, Erection, Testing and Commissioning at Site of the complete 220kV SF6 Gas Insulated Metals Enclosed Switchgear (GIS), 33kV Outdoor switchyard, 20MVA 220/33kV Power Transformer, Two nos. Auxiliary Transformer of 250kVA 33kV/415V, Outdoor Equipment, Associated Civil Works, Civil Buildings with the facilities for EOT crane, Approach Road from nearest public road, Internal Roads, Drains, civil buildings, foundations etc., GIS Ducts along with Termination Arrangements for making connections with Outdoor Transformers, and Control and Protection, Sub Station Automation System, and Fibre Optic Terminal Equipment and other Electrical and Mechanical Auxiliary Systems complete in all respects on Turnkey Basis.
- Laying of approx. 750m, Double circuit 220kV 1000sq.mm Copper XLPE cable from the GIS Substation to MRSS, including Supply and erection of Straight Through Joints (if applicable), Cable seal end and its support structure at Switching substation end and suitable Cable termination at MRSS end.
- It is the intent of this Specification to describe Primary Features, Materials, Design, and Performance Requirements and to establish Minimum Standards for the Work.
- The Specification is not intended to specify the complete details of various practices of Manufactures/ Bidders, but to specify the requirements with regard to performance, durability, and satisfactory operation under the specified site conditions.
- Detailed Scope of Work is brought out in subsequent Clauses of this Section.

SECTION-II DESIGN AND STANDARDISATION:

The Works covered by the specification shall be designed, manufactured, built, tested and commissioned in accordance with the Act, Rules, Laws and Regulations of India. The Equipment(s) shall also conform to the requirements detailed in the referred standards, which shall form an integral part of the Specification, in addition to meeting the specific requirements called for elsewhere in the Specification.

The Contract works shall be designed to facilitate inspection, cleaning and repairs, and for operation where continuity of supply is the first consideration. Apparatus shall be designed to ensure satisfactory operation in all atmospheric conditions prevailing at the Site(s) and during such sudden variation of load and voltage as may be met with under working conditions on the system, including those due to faulty synchronizing and short circuit.

The design shall incorporate all reasonable precautions and provisions for the safety of those concerned in the operation and maintenance of the Contract Works and of associated works supplied under other contracts.

Where the Specification does not contain characteristics with reference to workmanship, equipment, materials and components of the covered equipment, it is understood that the same must be new, of highest grade of the best quality of their kind, conforming to best engineering practice and suitable for the purpose for which they are intended.

In case where the equipment, materials or components are indicated in the specification as 'similar' to any special standard, the Engg. Incharge shall decide upon the question of similarity. When required by the Specification; or when required by Engg. Incharge the Contractor shall submit, for approval, all the information concerning materials or components to be used in manufacture. Machinery, equipment, materials and components supplied, installed or used without such approval shall run the risk of subsequent rejection, it being understood that the cost as well as the time delay associated with the rejection shall be borne by the Contractor.

The design of the Works shall be such that installation, future expansions, replacements and general maintenance may be undertaken with a minimum of time and expense. Each component shall be designed to be consistent with its duty and suitable factors of safety, subject to mutual agreements and shall be used throughout the design. All joints and fastenings shall be so devised, constructed and documented that the component parts shall be accurately positioned and restrained to fulfil their required function.

All outdoor apparatus and fittings shall be designed so that water cannot collect at any point. Grease lubricators shall be fitted with nipples and where necessary for accessibility, the nipples shall be placed at the end of extension piping.

All water and oil pipe flanges shall be to IS 6392/BS 4504 or other equivalent standard, as regards both dimensions and drilling, unless otherwise approved.

Cast iron shall not be used for chambers of oil filled apparatus or for any part of the equipment which is in tension or subject to impact stresses.

Kiosks, cubicles and similar enclosed compartments shall be adequately ventilated to restrict condensation. All contractor or relay coils and other parts shall be suitably protected against corrosion.

All apparatus shall be designed to obviate the risk of accidental short circuit due to animals, birds, insects, mites, rodents or micro-organisms.

Corresponding parts shall be interchangeable. Where required by the Engg. Incharge the Contractor shall demonstrate this quality.

The major electrical equipment/material being supplied should have been Type Tested and the provisions for the same shall be governed by "Guidelines for the Validity Period of Type Test(s) conducted on Major Electrical Equipment in Power Transmission System" issued by CEA in May'2020, read along with any amendments/revisions issued subsequently.

SECTION-III BASIC REQUIREMENTS AND GUIDELINES:

GENERAL CONDITIONS:

- A. All components and accessories required for the completion and successful operation of the WORK covered under the scope of this PROJECT, either specified in detail or not, shall be supplied and installed by the CONTRACTOR as necessary.
- B. The engineering design and specification of equipment/materials supplied under this PROJECT shall be in accordance with this Scope of work and Technical Specifications and in line with OPTCL Standards. If the equipment either does not conform to specifications or not acceptable to OWNER based on past operating experience/any other reason, the CONTRACTOR shall propose alternative equipment for review and acceptance by OWNER. However, in case of a conflict in the requirements, the CONTRACTOR shall bring this to the attention of the OWNER and shall obtain such applicable requirements for this PROJECT in writing from the OWNER. The CONTRACTOR shall have no right to decide on his own the requirements. In case of such a conflict, and in case of such an eventuality, he will be doing so at his own risk and cost as the OWNER reserves the right to reject any or the complete part of such work arising out of the CONTRACTOR'S own decision. The materials/equipments, engineering and construction requirements for this project shall be in accordance with latest OPTCL standards. All materials/equipments used for this project shall be procured from the OPTCL approved vendor list only.
- C. The drawings enclosed with this Scope of Work and Technical Specifications are conceptual and for the information of the CONTRACTOR only. The CONTRACTOR should read these drawings in conjunction with this Scope of work and Technical Specifications. The successful

CONTRACTOR shall develop detailed design drawings for construction purposes.

- D. CONTRACTOR should be responsible for the independent development of the information required to complete the specified PROJECT such as Existing/Ongoing Project drawings, design calculations, technical reports, etc.,
- E. The specification of equipment and materials specified herein are to be considered as the minimum requirements, and the bidders shall carry out their own basic and detailed design necessary for their proposed specifications.

The base design shall be finalized at base design review meeting based on the guideline drawings issued hereof, manufacture's drawings, calculations and data sheets, and detailed design shall be finalized based on the base design review and other required information.

All documents, drawings data and instruction books to be submitted by the CONTRACTOR shall be written in English language and Metric Unit system.

- F. All WORK, including services for the test and inspections required by the OPTCL and demonstrations, if any, for familiarization of operation, maintenance & commissioning of new type of switchgear, relays, meters, etc. to the OPTCL personnel by the manufacturer's representative shall be arranged/done by the CONTRACTOR.

The CONTRACTOR shall submit for OWNER review and approval, the demonstration package proposed by him giving the detail/list of equipment and devices that will be demonstrated.

- G. The CONTRACTOR'S organizational chart shall be prepared as specified in Instruction to Bidders on Technical Proposal.
- H. The CONTRACTOR shall submit along with bid proposal the operational spare parts listed in the SOR.

KICK-OFF MEETING:

A Kick-Off Meeting will be held in COMPANY Headquarters shortly after award of the CONTRACT. This meeting will cover PROJECT implementation, the Scope of work, and Schedule and will give the CONTRACTOR an opportunity to discuss all matters related to carrying out his responsibilities.

BASE DESIGN REVIEW:

After the completion of Base Design, CONTRACTOR'S Project Manager, Project Engineer and the Design/Construction Engineer in each field of specification shall attend the presentation meeting. During the meeting, the CONTRACTOR'S comments on the base design package will be reviewed and discussed in detail to finalize the base design for the PROJECT. Minutes of the meeting shall be prepared by the CONTRACTOR to be concurred by the COMPANY REPRESENTATIVE.

The final approval of the material shall be done only after consideration of comments generated during the Base Design Review meeting.

PROGRESS REPORTING:

- A. The CONTRACTOR shall submit Bi-weekly PROJECT Progress Reports, in OPTCL-approved formats for the PROJECT to the responsible OPTCL AUTHORITY. Soft copy of progress reports shall be submitted along with the hard copy. For this purpose, the total WORK shall be divided into:
 - 1. Procurement/Manufacture/Fabrication Inspection and Delivery of Materials/ Equipment.
 - 2. Construction and Installation.

3. Testing and Commissioning.
- B. The following information shall be included in the Progress Reports:
1. Percent of WORK completed as compared to the weighted schedule used to assess WORK progress. If progress is less than the scheduled one, its reason and proposal to overcome the same should be recorded.
 2. Statement of items worked on and/or completed during the period
 3. Statement of items to be worked on and/or completed during the following period
 4. Problem areas, which can have an adverse effect on the schedule
 5. Safety statistics and minutes of construction safety meeting and progress meeting
 6. Manpower and equipment availability against the schedule requirement
- C. Bi-weekly Progress Meeting shall be conducted between the OWNER and the CONTRACTOR during the entire CONTRACT duration of the PROJECT. Other coordination and interface meetings will be conducted, as required. The CONTRACTOR shall prepare the minutes of all meetings. The initial draft shall be submitted by the CONTRACTOR to the OWNER for review and concurrence. The CONTRACTOR shall then incorporate the required corrections and submit to the OWNER, one (1) original and two (2) copies after they are duly signed by the authorized representative of the CONTRACTOR. The OWNER shall sign one copy in acceptance and furnish it to the CONTRACTOR and retain the original.

In addition, a weekly Construction Safety Meeting shall be conducted by the CONTRACTOR'S Safety Supervisor or PROJECT Engineer. Minutes of meeting shall be forwarded to the OWNER.

QUALITY ASSURANCE:

General:

To ensure that the supply and services under the scope of this Contract, whether manufactured or performed within the Contractor's works or at his Sub-Contractor's premises or at Site or at any other place of work are in accordance with the Specification, with the Regulations and with relevant Indian or otherwise Authorized Standards the Contractor shall adopt suitable Quality Assurance Programmes and Procedures to ensure that all activities are being controlled as necessary.

The quality assurance arrangements shall conform to the relevant requirements of ISO 9001 or ISO 9002 as appropriate.

The systems and procedures which the Contractor will use to ensure that the Works comply with the Contract requirements shall be defined in the Contractor's Quality Plan for the Works.

The Contractor shall operate systems which implement the following:

Hold Point "A stage in the material procurement or workmanship process beyond which work shall not proceed without the documented approval of designated individuals or organisations."

The Engg. Incharge written approval is required to authorize work to progress beyond the Hold Points indicated in approved Quality Plans.

Notification Point "A stage in material procurement or workmanship process for which advance notice of the activity is required to facilitate witness."

If the Engg. Incharge does not attend after receiving documented notification in accordance with the agreed procedures and with the correct period of notice then work may proceed.

Quality Assurance Programme:

Unless the Contractor's Quality Assurance System has been audited and approved by the Engg. Incharge, a Quality Assurance Program for the Works shall be submitted to the Engg. Incharge for approval a minimum of one month prior to commencement of the works, or such other period as shall be agreed with the Engg. Incharge. The Quality Assurance Program shall give a description of the Quality System for the Works and shall, unless advised otherwise, include details of the following:

- The structure of the Contractor's organization
- The duties and responsibilities assigned to staff ensuring quality of work
- The system for purchasing, taking delivery and verification of materials
- The system for ensuring quality of workmanship
- The system for the control of documentation
- The system for the retention of records
- The arrangements for the Contractor's internal auditing
- A list of the administration and work procedures required to achieve and verify the Contract's Quality requirements. These procedures shall be made readily available to the Engg. Incharge for inspection on request.

Quality plans:

The Contractor shall draw up for each section of the work Quality Plans which shall be submitted to the Engg. Incharge for approval at least two weeks prior to commencement of the particular section. Each Quality Plan shall set out the activities in a logical sequence and, unless advised otherwise, shall include the following:

- An outline of the proposed work and program sequence
- The structure of the Contractor's Organization for the Contract
- The duties and responsibilities assigned to staff ensuring quality of work for Contract
- Hold and Notification points
- Submission of engineering documents required by the Specification
- The inspection of materials and components on receipt
- Reference to the Contractor's work procedures appropriate to each activity
- Inspection during fabrication/construction
- Final inspection and test

Inspection and testing:

The prime responsibility for inspection and testing rests with the Contractor. The inspection or its waiver by the Engg. Incharge does not relieve the Contractor of any obligations or responsibilities to carry out the work in accordance with the Contract.

The inspection and testing shall be documented such that it is possible to verify that it was performed. Records of inspection shall include as a minimum the contract identity, operation/inspection, technique used, and acceptance standard, and acceptability, identity of inspector/tester and date of inspection/test.

Non-conforming product:

The Contractor shall retain responsibility for the disposition of non-conforming items.

Monitoring of quality arrangements:

During the course of the Contract the Engg. Incharge may monitor the implementation of the Quality Assurance arrangements. Monitoring will be by surveillance of the activities at work locations and/or by formal audits of the adherence of the Contractor to the systems and procedures which constitute his Quality Assurance arrangements. Corrective actions shall be agreed and implemented in respect of any deficiencies

The Contractor shall provide any facilities, including access, which may be required by the Engg. Incharge for monitoring activities.

The Engg. Incharge may participate on an agreed basis in the Contractor's monitoring of a sub-contractor's Quality Assurance arrangements.

Sub-contractors:

The Contractor shall ensure that the Quality Assurance requirements of this Specification are followed by any sub-contractor appointed by him under the Contract.

The Contractor shall assess the sub-contractor's Quality Assurance arrangements prior to his appointment to ensure its compliance with the appropriate ISO 9000 standard and the Specification.

Auditing of the sub-contractor's Quality Assurance arrangements shall be carried out by the Contractor and recorded in such a manner that demonstrates to the Engg. Incharge the extent of the audits and their effectiveness.

Method statement:

Prior to commencing work, the Contractor shall submit a method statement setting out full details of his method of working. This is a **Hold Point**.

Details of the Contractor's method of working shall also be submitted at the time of Bidding.

HEALTH, SAFETY AND ENVIRONMENT (HSE) PLAN:

General

Within one month of award of contract the Contractor shall produce a HSE Plan for the contract and submit for the approval of the Engg. Incharge . The HSE Plan is described in the following sections.

The primary objective of the HSE Plan is for the contractor to demonstrate that he has the capability to carry out the contract work in a cost effective manner, giving due consideration to the Health, Safety and Environmental management of both his own employees, those of the

Employer and anyone who may be affected by his activities.

Content of HSE Plan:

The HSE Plan will comprise two parts i.e.:

Part: I: Sections 1 to 5, covering general HSE management and controls.

The following would be attached as appendices, where appropriate:

- Organization chart showing the proposed Contractors HSE organizational structure
 - (z) • The CV's, duties and responsibilities of the following personnel:
 - Contract Manager
 - (ii) Contractors Site Representatives
 - (iii) Safety Officer
 - (iv) Site Safety Officers

Part: II: Section 6, providing a summary of hazards and controls.

General structure of HSE Plan

The HSE Plan shall conform to the following general structure:

1. Contractors Policy Statement
2. Health
 - 2.1 First Aid
 - 2.2 Primary health care
 - 2.3 Occupational health
3. Safety
 - 3.1 Objectives and targets
 - 3.2 Organization and responsibilities
 - 3.3 HSE meetings
 - 3.4 Motivation and communication
 - 3.5 HSE training
 - 3.6 Audits and inspections
 - 3.7 Emergency response

- 3.8 Safety function
- 3.9 Accident investigating and reporting
- 3.10 Standards
- 3.11 Personal protective equipment
- 4. Environment
 - 4.1 Waste management
 - 4.2 Chemicals management
 - 4.3 Environmental impact
- 5. Critical areas
 - 5.1 Subcontractors
- 6. Summary of hazards and controls

Section 6 of HSE Plan:

In addition to general hazards and their controls, the following hazards have been identified as specific to this contract and therefore the contractor should demonstrate that he is capable of providing the necessary controls for the work:

- Working within a Permit to Work system
- Working adjacent to live high voltage equipment
- Working adjacent to, and in the vicinity of, live high voltage overhead lines
- Working at elevation
- Lifting operations
- Use of explosives
- Use of heavy machinery including cranes, pile rigs and concrete mixers
- Excavation works
- Work in confined spaces
- Working with insulating oil
- Working with compressed gas
- Rotating machinery

The Contractor should demonstrate his understanding of these hazards by either proposing specific controls for each of them or by giving supporting documentation which demonstrates that such controls already exist.

Standards, Procedures and Guidelines:

The HSE Plan shall identify the Standards, Procedures and Guidelines that will be applicable to the project. These will include the Indian Electricity Rules and The OPTCL Operations Safety Manual– 1997 (Draft), and will be subject to the approval of the Engg. Incharge (Divisional Engr.).

Supervision strategy:

The Contractor will provide supervisors with a minimum of five years experience of this type of work such that they are able to supervise the quality and standards of the work without intervention by the Employer. The role of the Employer will be to monitor and audit the quality of the work to ensure that it is of adequate standard and that it is being safely and successfully managed.

LANGUAGE AND SYSTEM OF UNITS:

The English language shall be used in all written communications between the Employer, the Engg. Incharge (Divisional Engr.) and the Contractor with respect to the services to be rendered and with respect to all documents and drawings procured or prepared by the Contractor pertaining to the work, unless otherwise agreed by the Employer.

It is required that danger plates, equipment designation labels or plates, instruction notices on plant and general substation notices be written in English, Hindi and Oriya. Control switch and lamp labels, indicator lamp and annunciator inscriptions shall be in English only.

The Contractor must furnish a schedule giving the English, Hindi and Oriya version of all labels, notices, etc., for approval.

The design features of all equipment shall be based on the SI system of units.

CORRESPONDENCE, DRAWINGS, APPROVAL PROCEDURE AND SAMPLES:

Correspondence:

All correspondence shall be addressed to as per the discretion of the Employer

Drawings and samples:

The Contractor shall provide free of charge any additional drawings and/or copies of any drawing required by the Engg. Incharge.

Within 30 days of contract commencement the Contractor shall submit, for approval by the Engg. Incharge a schedule of the drawings to be produced detailing which are to be submitted for “Approval” and which are to be submitted “For Information Only”. The schedule shall also provide a programme of drawing submission, for approval by the Engg. Incharge that ensures that all drawings and calculations are submitted within the period specified above.

All drawings submitted by the Contractor shall be in sufficient detail to indicate the type, size, arrangement, material description, Bill of Materials, weight of each component, break-up for packing and shipment, the external connections, fixing arrangement, and the dimensions, required

for installation and interconnections with other equipment and materials, clearances and spaces required for installation and interconnections between various portions of equipment and any other information specifically requested in the specification.

The Contractor shall submit samples of materials for approval as required from time to time by the Engg. Incharge.

All dimensions marked on drawings shall be considered correct although measurement by scale may differ from general arrangement drawings. Detailed drawings shall be worked to where they differ from general arrangement drawings.

All detail drawings submitted for approval shall be to scale not less than 1: 20. All-important dimensions shall be given and the material of which each part is to be constructed shall be indicated on the drawings.

All documents, drawings and samples shall be submitted in accordance with the provisions of this Specification and shall become the property of the Employer.

All drawings and calculations, submitted to the Engg. Incharge shall be on international standard size paper, either A0, A1, A2, A3 or A4. All such drawings and calculations shall be provided with a contract title block and shall be assigned a unique project drawing number; the contract title block and project numbering system shall be agreed with the Engg. Incharge .

Technical drawings must be shown, in such a form that the information necessary to construct an installation or part of an installation must be understandable by the technicians/skilled workmen responsible for construction and supervision. The drawings must therefore conform to following standards.

For presentation of design drawings and circuit documents IEC Publication 617 or equivalent standards for graphical symbols are to be followed.

Script sizes and thickness of scripts and lines be selected so that if reduced by two stages the alphanumeric characters and lines are still perfectly legible so as to microfilm them.

Approval procedure:

The Contractor shall submit all drawings and samples for approval in sufficient time to permit modifications to be made if such are deemed necessary, and the drawings and samples to be re-submitted without delaying the initial deliveries or completion of the Contract Works.

Three copies of all drawings shall be submitted for approval and three copies for any subsequent revision. The Engg. Incharge reserves the right to request any additional information that may be considered necessary in order to fully review the drawings. Drawings for approval shall be submitted as paper prints and shall bear the approved contract references. Submittal should where possible be staggered to facilitate maintenance of the above schedule.

If the Engg. Incharge is satisfied with the drawing, one copy will be returned to the Contractor marked with "Approved" stamp. If the Engg. Incharge is not totally satisfied with the drawing, then "Approved subject to comment" status will be given to it and a comment sheet will be sent to the Contractor. If the drawing does not comply with the requirements of the specification then it will be given "Not Approved" status and a comment sheet will be sent to the Contractor. In both the latter cases the Contractor will have to modify the drawing, update the revision column and resubmit for final approval.

Following approval copies of final drawings will be required as given below.

- Reproducible on Tracing Films or Papers : 3 copies
- Hard Copies on paper (Blue print or Xerox) : 20 copies
- Computer CD ROM : 1 copy

Any drawing or document submitted for information only should be indicated as such by the Contractor. Drawings submitted for information only will not be returned to the Contractor unless the Engg. Incharge considers that such drawings do need to be approved, in which case they will be returned suitably stamped with comments.

Drawings, samples and models submitted by the Contractor and approved by the Engg. Incharge shall not be departed from without the instruction in writing of the Engg. Incharge .

The Contractor shall be responsible for any discrepancies or errors in or omissions from the drawings, whether such drawings have been approved or not by the Engg. Incharge Approval given by the Engg. Incharge (Divisional Engr.) to any drawing or sample shall neither relieve the Contractor from his liability to complete the Contract Works in accordance with this Specification and the conditions of contract nor exonerate him from any of his guarantees.

If the Contractor needs approval of any drawing within a period of less than four weeks in order to avoid delay in the completion of the Contract Works, he shall advise the Engg. Incharge when submitting the drawings and provide an explanation of the document's late submission. The Engg. Incharge will endeavor to comply with the Contractors time scale, but this cannot be guaranteed.

Final as-built drawings:

After completion of work on site all drawings shall be revised where necessary to show the equipment as installed and three copies submitted duly signed by site-in charge. Following approval, two reproducible transparencies and twenty prints shall then be provided as required by the Engg. Incharge and shall be of sufficient detail to enable all parts to be identified. The contractor shall also submit, where possible, digitally stored copies of all as-built drawings on disc or CD-ROM in a format compatible with the Employer's drawing system.

Operation and Maintenance Manuals:

Six months prior to the contractual completion date for each substation site the Contractor shall forward to the Engg. Incharge, two copies of the Operation and Maintenance Manual unique to the substation site being handed over.

After approval by the Engg. Incharge the Contractor shall deliver Three (3) copies of the complete manual.

The Taking over Certificate will not be issued until the required number of approved copies of the manuals have been provided by the Contractor.

The manuals shall be as complete and as specific as possible and shall incorporate documentation that is specific to the materials and equipment used on the contract. Because the nature of the work varies from site to site the manuals will have to be tailored to the specific needs of each site.

All precautions and warnings relative to the safety of life and equipment shall be included in the manuals.

The manuals should also show exploded views wherever required.

MASS AND SIZE OF PARTS AND QUANTITIES OF OIL:

The mass and dimensions of any item of equipment shall not exceed the figures stated in the Schedules.

Each item shall be labelled to indicate its mass, quantity of oil (if any) and any special handling instructions.

TEST RECORD BOOK:

A. The CONTRACTOR shall provide a““Test Record Boo””, which shall include the following:

1. Factory test report of each particular equipment installed.
2. Field test report, which shall include the following:
 - a. Description of Equipment Tested and Manufacture’s Nameplate Data
 - b. Description of Test
 - c. List of Apparatus with Calibration Data
 - d. Test Results
 - e. Conclusions and Recommendations
 - f. Appendix, including test forms

The factory test results, equipment manuals, scope of work and relevant contract specifications shall be available at site before starting pre-commissioning tests.

- B.** Each test form where applicable shall include a column quoting the acceptable maximum and minimum limits of the test in terms of voltage, current, frequency, time, etc., and include “As Found” and “As Left” values.
- C.** Three (3) copies of the““Test Record Boo”” are to be submitted within thirty (30) days after commissioning the Project.
- D.** Two (2) soft copies of all the above documents compiled in CDs in pdf. Format. The records shall be organized by station, voltage level and equipment (using company approved designation as per final as built drawings) with not more than one station in one CD. Each test record shall be stored as a separate file with the file name clearly and accurately describing the content. Each disc shall have a text file in the root directory containing a comprehensive table of contents in the entire set of CDs. The CDs shall be labelled with the project title, contract number, completion date, station name and disc sequence number.

LOSS PREVENTION REQUIREMENTS:

The CONTRACTOR and/or CONTRACTOR’S SUBCONTRACTOR(s) shall strictly comply with the following Loss Prevention requirements.

General Requirements:

1. Adherence to all applicable provisions of the OWNER Accident Prevention Manual and

Construction Safety Manual.

2. Compliance with the provisions of the OPTCL General Instructions on WORK Permit and Clearance Procedure. The CONTRACTOR shall have an authorized employee with certificate to receive WORK Permit. If the CONTRACTOR has no authorized employee, or has an employee with expired certificate, he shall be responsible to coordinate with the OWNER REPRESENTATIVE for scheduling of WORK Permit training course. All activities of the CONTRACTOR near or inside the substation shall be allowed only after securing WORK Permit.
3. The CONTRACTOR shall submit his Loss Prevention Program to the OWNER sufficiently in advance to obtain OPTCL approval prior to commencement of WORK at site. CONTRACTOR shall conduct a safety presentation of the Safety & Loss prevention program to OWNER prior to approval of the program by the OWNER. The Loss Prevention Programs shall contain the following:
 - a. Cover Page complete with references, as follows:
 - CONTRACTOR'S Name
 - Title of Submittal
 - PROJECT Title and Location
 - CONTRACT Number
 - COMPANY'S Name
 - Date and Revision
 - b. Table of Contents
 - c. CONTRACTOR'S Safety Policy Statement complete with signature over printed name and title of CONTRACTOR'S Management REPRESENTATIVE.
 - d. Specific program items (suitable for the SOW) that the CONTRACTOR proposes to implement during the CONTRACT execution.
 - e. Attachments necessary to supplement the program.
 - PROJECT Table of Organization
 - Construction Schedule
 - Equipment Schedule
 - Manpower Schedule
 - CONTRACTOR'S standard forms for safety related reports
 - Temporary Facility layout
 - Location plan
 - Copy of valid certificate of first aid
 - Electrical equipment Layout drawing showing temporary facilities, main power source, grounding, fire protection equipment etc.
4. The CONTRACTOR shall provide necessary personal protective clothing (i.e. head, eye, face, hand, and foot protection) and respiratory protective equipment including personal protective equipment for fall protection such as safety belts and lifelines, and implement wearing them.
5. The CONTRACTOR shall provide and use adequate and suitable safety/ warning signs, cordon tapes, portable barricades, warning lights and personnel protective equipment at the JOBSITE to protect the safety of OWNER and CONTRACTOR personnel and the public, and to prevent damage to property.
6. Provision of traffic warning or control warning devices when working near or along roadways, for safety of personnel and the public. When required by the OWNER REPRESENTATIVE, the CONTRACTOR shall provide personnel (as flagman) to direct and maintain traffic in affected roadways.
7. The CONTRACTOR shall provide of first-aid facilities and must have a certified employee to

administer first aid and Cardio Pulmonary Resuscitation (CPR). A valid copy of first aider certificate shall be attached with the Loss Prevention Program.

8. The CONTRACTOR shall refrain from using mechanized excavation equipment within restricted areas unless cleared and permitted to do so.
9. The CONTRACTOR shall request in advance a clearance for de-energizing the interfacing points and observe grounding procedures.
10. The CONTRACTOR shall obtain from the OWNER, ID cards for his employees and stickers for his vehicles/equipment prior to mobilization to site.
11. In order to prevent theft/loss of materials/equipment, the CONTRACTOR shall take the necessary measures and precautions including but not limited to the following:
 - a. All materials provided or used in this CONTRACT shall be stored by the CONTRACTOR in safe and secured locations even if stored for short period of time.
 - b. If the equipment/materials are to be stored in the substation area for a prolonged period, the CONTRACTOR shall ensure that they are kept in locked containers or any other appropriate method of storage such that the materials/equipment are not easily noticeable by people with intention of theft or pilferage. Moreover, such containers shall be placed at a distance from the fence/boundary wall.
 - c. CONTRACTOR shall also consider other factors (i.e. temperature, humidity, etc.) affecting the storage of materials/equipment being stored in containers, to avoid any damage during such storage period.
12. The CONTRACTOR shall employ qualified safety supervisor/ safety engineer to coordinate, administer and ensure full implementation of the program. The nominated safety supervisor/ safety inspection engineer shall be pre-qualified by the ISD/ Fire Fighting & Loss Prevention Division upon execution of contract.

PROJECT Involving Elevated Works:

1. The CONTRACTOR shall submit his heavy equipment (i.e. cranes and bucket trucks) to the OWNER for safety inspection and certification and correspondingly stick with green safety sticker.
2. The CONTRACTOR'S ladders shall conform to OSHA (Occupational Safety and Health Administration) standard. Safety practices shall be followed in positioning ladders. Scaffolds shall be designed, built and inspected by a competent engineer prior to its use.

PROJECT Involving Welding and Cutting Operations:

1. The CONTRACTOR shall provide suitable fire extinguishers to be used in case of fire emergencies.
2. The CONTRACTOR shall provide the welding gas cylinders with suitable rack that is equipped with security chain(s). **Contractor shall also provide safety protective gears as follows:**
 - a. **Hard hats**
 - b. **Gloves**
 - c. **Ear Protection**
 - d. **Safety Glasses**
 - e. **Harnesses and dust mask**

PROJECT near Energized Lines or Equipment:

Observe working clearances when working near or about energized line or equipment as per OPTCL'S Accident Prevention Manual. CONTRACTOR may require coordinating with the OPTCL REPRESENTATIVE to work under permission or NO TEST ORDER (NATO) provided line or Equipment will remain hot.

PROJECT Requiring Use of Chemical(s):

Submit material safety data sheets (MSDS) of chemicals required or which are to be used in the execution of the PROJECT.

OPERATIONAL SPARE PARTS:

The successful bidder/CONTRACTOR shall submit itemized prices and complete technical data/ brochures for the spare parts.

These shall be in accordance with the requirements as listed in the SOR of this contract.

WORKING HOURS:

During the construction phase of the Project, the Contractor shall work in the normal working hours of the Company, unless otherwise instructed by the OWNER. The Contractor shall coordinate with the Company to get work permit before commencing the job.

SECTION-- IV SCOPE OF WORK:

GENERAL:

1) Electrical:

The scope includes but is not limited to:

- A. Design, Engineering, Supply Erection, Testing & commissioning of the following equipment:
- a. Power transformer & Auxiliary transformers
 - b. 220kV GIS Equipment along with allied accessories / material / equipment
 - c. 220kV Outdoor Equipment & 33kV Outdoor Equipment.
 - d. 33kV CT, VT console boxes with aluminium alloy having minimum three mm thickness.
 - e. All out door kiosks/boxes, shall be GI sheet of minimum 2mm thickness with aluminium alloy *canopy* (rain hood) of 3mm thickness.
 - f. Protection, control, and metering systems as per Protection Single Line diagram attached.
 - g. Insulator strings with hardware
 - h. Bus-bar, circuit conductor and all conductor accessories. Other interconnection shall be through single/twin Moose ACSR.
 - i. Power and control cables, cabling accessories, cable trays etc. Proper sealing of the cable entry (control & Power) at Control Room building, to prevent water entering from switch yard/outside to CR Building, preventing entry of rats and reptiles, Fire proof etc.
 - j. AC/DC systems including all distribution boards, battery and charger systems.
 - k. Air conditioning and systems for control room
 - l. Firefighting systems and equipment
 - m. Steel structures for switchyard gantries and portals (lattice type); and equipment (pipe or lattice type) including those for lightning protection.
 - n. Earthing system and earthing conductors.
 - o. Testing and maintenance equipment.
 - p. Lighting of substation area and substation buildings. Illumination and emergency lighting system at different locations.
 - q. Control and relay panels as proposed.
 - r. AC and DC distribution boards as per requirement and as proposed.
 - s. Bus bar protection scheme.
 - t. Disturbance recorder with Time synchronization.(GPS)
 - u. Substation level PC/Lap top provision for Relay configuration with their software.
 - v. Any other items required for completion of the project are also in the scope of this contract in order to complete the sub-station in all respect.
 - w. Supply of all clamps, connectors and hardware required for commissioning of the substation. The quantity and rating of the connectors and clamps are dependent on the layout and requirement of the substation.
 - x. Supply and putting of sub-station illumination system. All the light fittings shall be LED type & these fittings shall be mounted on switch yard portal structures such as columns & beams. No separate lighting mast is required. Entire substation lighting system in the switch yard shall be designed using underground cables only. No overhead conductors are permitted for this purpose. For street lighting one outdoor lighting kiosk with two incomers of 200A rating switch fuse units (SFU) & with six feeders of 32A rating fitted with MCB shall be considered.
 - y. Designing and providing the earth mat and earthing of the sub-station lighting protection, equipment earthing etc. Earth mat shall be designed using as per Technical Specification mentioned at relevant Chapter. Water tap provision shall be provided for pouring water into the earth pits constructed inside & around the periphery fence the switch yard. The earthing shall be extended beyond 2 **metres** from the fencing and the fencing earthing are also to be taken care.

- z. Making suitable changes at 220kV Line remote end Substations w.r.t. Communication & Protection Main 1 and Main 2 Distance and Line Differential Protection with all necessary modifications including necessary aux realys for two lines.
- aa. Laying, jointing (if applicable) and termination of 220kV 1000qsmm XLPE cable from 220kV GIS station to MRSS. Cables will be supplied by TFL. Two sets straight thru joint and the Joint Pits shall be in contractor scope.

B. Supply of the following equipment:

- a) Mandatory spares for substation equipment being supplied under this contract as per SOR of this contract.
- b) Maintenance & testing equipment etc. as per the list provided in relevant chapter of technical specifications.

2) Civil works:

The design, engineering, supply of all materials including cement and steel, consumables, as per specification and approved drawings for civil works of the substation including but not limited to the following;

- i. Designing, fabrication, galvanizing and erection of structures on respective foundations detailed in specification for civil works. Supply of all structural materials (columns & beams, hardware & fasteners etc.) as per requirement. The contractor shall preferably adopt OPTCL designed standard structures for use in various substation.
- ii. Soil testing for soil resistivity and soil bearing capacity before designing.
- iii. Site development including levelling, filling & compacting of the sub-station area to the desired height.
- iv. Wherever pile foundations are required for Control room or GIS building, switchyard tower columns, Equipment foundation and transmission line towers etc., these are to be constructed as per the guideline indicated in the specification elsewhere. The type of pile foundations can be ascertained only after soil investigation and approval of the same.
- v. Construction of sub-station retaining wall with brick masonry and fencing by GI heavy-duty goat mesh fencing as per site requirement.
- vi. Construction of boundary wall along the property line of the substation with Main gate, security shed and switch yard gates in the sub-station. Provisions of a security shed near the main gate. The structure shall be RCC framed structure. There shall be provision of electrical illumination facilities.
- vii. Fencing of switch yard area and other areas like station transformer area.
- viii. There shall be provision of plantations of fruit bearing and flower bearing plants and gardens in and around the sub-station along with water tap provision for watering the plants in the sub-stations.
- ix. Construction of all foundations for columns, all switchgear and other substation equipment.
- x. Construction of foundation of transformer including supply and putting of rail from the service bay to the transformer plinth, all foundations of columns, equipment structures. Separate foundations for the marshalling boxes of the isolators are to be considered.
- xi. Anti-termite treatment of switch yard.
- xii. Switch yard buildings such as control room GIS Room etc. as per requirement mentioned in the specification elsewhere. There shall be provision of a water cooler including water purifier inside the control room building. Provision of split type air conditioners inside the control room building and conference area.
- xiii. There shall be provision of store shed, and open yard platform to store the materials like transformer bushing, CT, CVT and other equipment.
- xiv. Supply and spreading of uniform 20mm (or as per relevant Technical Specification) nominal size HG metal of 100mm thick inside the switch yard area of the Sub- Stations. The spreading will be done above a finished level of switchyard land by plain cement concrete (PCC) of thickness 75

- mm (ratio 1:4:8). Anti-weed treatment of the switch yard area to be made as per prevailing practice before spreading of PCC.
- xv. Construction of drainage system of the sub-stations & flood water discharge systems. Miscellaneous works like manholes soak pits, RCC trench, fencing, etc. in the switch yard.
 - xvi. Construction of rainwater harvesting arrangements in the substation.
 - xvii. Construction of cable trenches with trays & covers & sump pit with pump, as per requirement.
 - xviii. Construction of approach road to the new sub-station as per requirement. Construction of periphery roads inside the fencing. The roads inside the switch yard, at the periphery shall be of 3.75 metres wide & shall be of concrete road as per technical specification. The other roads main and approach road shall be 7 metres wide. The Main Road shall be of concrete & the approach road shall be of bitumen. Road in front of transformer shall be 7.0 metres wide concrete road.
 - xix. Modular Multi-diameter flexible Cable sealing system consisting of frames, blocks and accessories to be installed wherever the electrical / control / communication cables over-ground enter or leave from control room building. Cable sealing to be done with Multi-diameter type flexible modular based sealing blocks of different sizes (size 20: 4mm to 14.5 mm ,size 30 : 10mm to 25 mm ,size 40: 21.5mm to 34.5mm , size 60: 28mm to 54 mm , size 90: 48mm to 71 mm , size 120 : 67.5mm to 99 mm **or any convenient size**) to be provided for simple, easy and quick to assemble & re-assemble. some spare blocks on the frame to be provided with usable Multi-diameter blocks with centre plug, so that these spare blocks can be used for expansion in future for wide range of cables, solid blocks should not be used on frame. Cable sealing system should have been type tested for fire / water / smoke tightness and supplier shall have local presence by way of full infrastructure having service support, training support and stocks support and also have necessary sales support for any change / extension in future. Frames & stay-plate material should be galvanized steel and for compression single piece wedge with galvanized steel bolts should be used.

3) **Standards:**

All materials and equipment shall generally comply in all respects with the latest edition of the relevant Indian Standards. International Electro-Technical Commission (IEC) or any other internationally accepted Standard equivalent or better than relevant Indian Standard. Equipment complying with all other authoritative standards such as BIS & British standards. will also be considered if performance equivalent or superior to Indian Standard is ensured. In the event of supply of equipment confirming to any International or internationally recognized Standard other than the Standard listed in the Specification. The salient features of comparison shall be brought out and furnished along with the bid. In case of adopting any standard other than that IS or IEC, a complete set of adopted standard shall be supplied by the bidder. However it is desirable and preferred that the equipment offered shall comply with one consistent set of standard unless other than exceptional cases.

The equipment shall also comply with the latest revision of Indian Electricity Act and Indian Electricity Rules and any other Electrical Statutory Provision, Rules and Regulations.

4) **Packing and Marking:**

The bidder shall include and provide for securely protecting and packing the plant so as to avoid damage in transit under proper condition and shall be responsible for all loss or damage caused by any defect in packing. Large and heavy items such as 220kV and 33kV equipment and structural steel shall be packed and shipped as per standard international practice.

Container/Carpoons, boxes, trunks and other packages shall be strong and sturdy in construction to withstand Ocean shipping, loading and unloading, transport on rough roads, and storage in tropical area and hauling and handling during erection etc. Boxes and packages shall also be protected by suitable packing with the help of wooden planks/MS frame or galvanized steel strips.

A layer of waterproof material shall be provided inside the cartoon/boxes/packages to protect the equipment from water seepage and to avoid rust.

The following information shall be marked on the container/boxes/packages etc.

- Contractor's/manufacturer's name, project title and contract reference.
- Plant/accessory identification No. and title.
- Net/gross weight.
- OWNER'S name with other dispatch particulars such as destination.

The OWNER shall take no responsibility for any damage done to the plant on route to the site of work or place of delivery whichever is applicable.

5) Tests:

- a) Unless otherwise specified in respective section, all equipment shall be subjected routine, acceptance and type test as covered and specified in any standard in presence of the authorized representative of the OWNER.
- b) Bidder shall submit type test report from a recognized laboratory.
- c) At least 15 days advance notice shall be given by the CONTRACTOR to the OWNER for witness the tests.
- d) 220/33kV 20 MVA Power Transformer shall be mandatorily subjected to Short Circuit Test at any of the Govt. Lab in India or as per the decision of the employer.

6) Compliance to IE rule 1956:

- A. The construction agency shall possess a safety manual duly approved by competent authority in the Govt. of his State Governing the safety in work by the personnel and staff.
- B. The agency shall possess valid CONTRACTOR'S license issued by the Electrical Licensing Board of Odisha (ELBO) failing which he will not be allowed to start the work.
- C. Supervisors of works shall possess appropriate valid supervisory certificate of competency issued ELBO, Odisha.
- D. At least 50% of electrical workmen employed in the project shall possess valid workmen permit by ELBO.

7) OPTCL adopted standard switch yard structure:

The bidders may adopt their own type tested design for switchyard structures with approval from OPTCL. However the standard switch yard structures adopted in OPTCL switch yards system is given below. The height & weight are indicative only.

220 KV SIDE:

- COLUMN: P1S TYPE – HEIGHT-21.5 MTRS, WEIGHT-4.464 MT
- BEAM:Q1 TYPE – LENGTH-18 MTRS, WEIGHT-1.473 MT

8) Portable Fire Extinguisher:

List for Portable fire extinguishers of the following types to be supplied at sub-station.

Sl. No	Description of Items	Unit	Capacity	Quantity Required
1	Foam Type	Nos	9 ltrs	4
2	Dry chemical Powder Type (Trolley mounted)	Nos	22.5 Kgs	2
3	Dry Powder Type	Nos	5 Kgs	2
4	Carbon Dioxide (CO ₂)	Nos	4.5 Kgs	5
5	Carbon dioxide (CO ₂) Trolley mounted	Nos	22.5 Kgs	2

6	Fire bucket with (a set comprises of six nos. Bucket in each stand & one stand)	Set		3
7	9 liter water type	Nos	9 litre	4
8	50 Liters Mechanical Foam type	Nos	50 Litres	2

The quantities are indicative. Bidders are advised to design as per the requirement.

9) **Maintenance & Testing Equipment:**

Maintenance & testing equipment shall be supplied as per the requirement mention in relevant section of the Technical Specifications. Indicative list given below.

Sl. No	Description of Items	Unit	QUANTITY REQUIRED
			At each 220/33 KV S/S
1.	220kV Transformer oil breakdown voltage test set	Nos	1
2.	Insulation resistance tester (megger)	Nos	1
3.	Oil sampling bottle	Nos	4
4.	SF6 gas leak detector	Nos	1
5.	LCD, digital multimeter	Nos	2
6.	Analogue Multimeter (features same as digital multimeter)	Nos	1
7.	LCD, clamp on meter	Nos	2
8.	Digital earth tester	Nos	1
9.	Discharge rod as per standard for carrying out the switch yard maintenance work	Nos	6
10.	Rubber gloves of operation of isolators and earth switch	Pairs	2
11.	Relay tools kit	Sets	1
12.	Portable emergency light	Nos	4
13.	Latest version desktop PC of reputed make with all its accessories including CPU, Monitor, UPS and having all latest loaded software and also its back up in shape of CD and separate pen drive . Suitable for loading of software as recommended by the relay manufacturer. It includes supply of one no portable laser printer of reputed make. Make of PC and printer: HP/DELL	Set	1

** The multi meters (both digital and analogue), clamp on meters shall of "Fluke/ Megger/ Motwane make. Prior approvals of OPTCL for all the testing equipments are to be taken.

*** Earth tester & Insulation resistance tester shall of M/S Megger.

**** The oil BDV tester shall be of microprocessor based having printing facility

10) SPECIAL TOOLS AND TACKLES:-

The Bidder shall include in his proposal the deployment of all Special Tools and Tackles required for Erection, Testing, Commissioning, Operation, and Maintenance of the Equipment. The Special Tools and Tackles shall only cover Items, which are specifically required for the Equipment offered and are proprietary in nature. However, a List of all devices should be indicated in the relevant Schedule provided in the SOR. In addition to this, the Bidder shall also furnish a List of Special Tools and Tackles for the various Equipment in a manner to be referred by Owner during the Operation of this Equipment.

11) Office Furniture:

Office furniture shall be supplied & installed at each substation as per the list given below. All the furniture shall be of Godrej make. Before supply of the furniture to the sub-station, approval from OPTCL is required. Details of the scope of supply are mentioned at relevant section of this Technical Specifications.

Note: The selection of the above furniture shall be based on the latest models of Godrej make. The firm to obtain approval on the models to be supplied prior to finalization from the Engineer in Charge.

12) Additional Maintenance Tools:

- **Portable Aluminium ladder extendable type of 3m+ 3m to be used for maintenance of equipment inside switch yard;**
Heavy duty two fold with sliding feature aluminium ladder to be used for the maintenance work equipment in the switch yard (220kV & 33kV-CT, VT, and Isolators etc.) & also street lighting maintenance. Each fold will be of minimum height of 3 Mtrs. and should have better locking arrangement between each folds for better rigidity.
- **Pedestal mounted wheel fitted derrick for lifting/ lowering of materials up to 1.5 ton capacity;**
Heavy duty Pedestal mounted wheel fitted derrick for lifting/ lowering of materials up to 1.5 ton capacity to be used for the maintenance work equipment in the switch yard (220 KV & 33kV: Breaker, CT, VT, Isolators etc.) & also other maintenance works.

13) ENERGY METERING SYSTEM:

Main & Check metering system shall be provided at 220kV Line feeding TFL MRS Station as per OPTCL & TPCODL (Distribution Licensee) requirement. After Commissioning the S/S will be handed over to OPTCL for operation and maintenance, it is preferred to have the outdoor yard providing 220kV CT & PT of metering class and Metering cubicle as per Standard requirement. The same will be followed 33kV Line feeders which has separate MCT & MPT in the switchyard for the purpose of metering.

ELECTRICAL EQUIPMENT AND FACILITIES AT TFL 220 / 33 kV SS:

Provide and install the following electrical equipment and facilities as per requirements/ratings indicated below for 220/33kV OPTCL S/S.

220kV GIS SYSTEM:

The 245 kV, 50 Hz, Short Circuit Current Rating of 50 kA for 3 sec, SF6 Gas Insulated Switchgear shall have Double Bus Bar Arrangement 6 numbers of Bays (1 number - Transformer Bay for 220/33kV Transformer, 2 number of line bay to TFL MRSS Stations, 1 number - Bus Coupler Bay, 2 number - Line Feeder Bays). Provision and space for 2 no. future bays shall be provided in GIS Hall and Jointing Plugs required for future extension bays, in addition to that Associated Local Control Panels, Control Cables, all Consumable and Hardware's etc. The SF6 Gas Insulated Switchgear shall be of the Indoor Metal Enclosed type, comprising of following Modules:

a) Sets of 3150A, Three single phase (Isolated) single / three phase encapsulated, SF₆ Gas Insulated Metal Enclosed Bus Bars, each Bus Bar comprising of:

- (i) Bus Bars Enclosures running the length of the Switchgear to interconnect each of the Circuit Breaker Bay Modules in Double Main Bus System.
- (ii) Three numbers, single phase Inductive Voltage Transformers (VTs) complete with Isolator / Disconnecter Switch
- (iii) One number, 3 - phase, single pole, and group operated Safety Grounding Switch, complete with manual and motor driven operating mechanisms before each VTs.
- (iv) One number, 3 – phase, High Speed Fault Make Grounding Switches, complete with group operated manual and motor driven operating mechanisms for bus bar earthing.
- (v) GIS Ducts with Gas Monitoring Devices, Barriers, Pressure Switches, UHF PD sensor etc., as required
- (vi) Terminal Boxes
- (vii) Interconnecting Wiring / Piping
- (viii) Grounding, Support Structures and Platforms
- (ix) Local Control Cubicle
- (x) Shall have provision for measuring Partial Discharge on the Bus
- (xi) GIS Bus bar Extension provision has to be provided for future Extension.

b) BUS COUPLER Bay Module comprising of:-

- (i) 3150 A, 50kA for 3 sec., Single/Three - phase, SF6 Gas Insulated Circuit Breaker with Horizontal/Vertical Arrangement, complete with operating mechanism.

- (ii) Single phase Multi core Current Transformers with cores equally distributed across the Circuit Breaker (Ratio : 1200–600-300 / 1 A), Two numbers, 3 - phase, single pole, and group operated Bus Bar Isolator/ Disconnecter Switches complete with manual and motor driven operating mechanisms.
 - (iii) Two sets of 3150Amp, 3 - phase, single pole, and group operated Safety Grounding Switch and complete with manual and motor driven operating mechanisms.
 - (iv) GIS Ducts with Gas Monitoring Devices, Barriers, Pressure Switches, etc., as required.
 - (v) Local Control Cubicle.
- c) TRANSFORMER Feeder Circuit Breaker Bay Module for 20MVA, 220/33kV Three phase power Transformer, comprising of:-**
- (i) 3150A, 50kA for 3 sec., Single phase, SF6 Gas Insulated Circuit Breaker with Horizontal/Vertical Arrangement, complete with operating mechanism.
 - (ii) Three numbers, single phase Current Transformers with cores equally distributed across the Circuit Breaker (Ratio: 240-120-60/1A), (Ratio: 1200-600-300/1A - Busbar protection core).
 - (iii) Three numbers, 3150A, 3 - phase, single pole, group operated Isolator / Disconnecter, Switches complete with manual and motor driven operating mechanisms
 - (iv) Three numbers, 3- phases, single pole, group operated Safety Grounding Switches complete with manual and motor driven operating mechanisms.
 - (v) Three numbers 1 - phase, SF6 Ducts and SF6 / Air Bushing for Outdoor to connect to 220/33kV Transformers with 220kV GIS through SF6 Ducts to complete Transformer Bay Module.
 - (vi) Gas Ducts with Gas Monitoring Devices, Barriers, Pressure Switches, UHF PD sensor etc., as required
 - (vii) Local Control Cubicle
- d) TRANSMISSION LINE Feeder Circuit Breaker Bay Modules on 220kV incoming line and 220kV Cable feeders to TFL MRSS, each comprising of:-**
- (i) Single phase 3150A, 50kA for 3 sec., SF6 Gas Insulated Circuit Breaker with Horizontal/Vertical Arrangement, complete with operating mechanism for Outgoing Feeder.
 - (ii) Three numbers, single phase Multi core Current Transformers with cores equally distributed across the Circuit Breaker (Ratio: 1200 –600-300 / 1 A).
 - (iii) Three numbers, single phase Inductive Voltage Transformers (VTs) complete with Isolator/Disconnecter Switch
 - (iv) Transmission line bay only 3-core VT required with secondary junction box with protection & metering purpose.
 - (v) Three numbers, 3150A, 3-phase, single pole, group operated Isolator / Disconnecter Switches, complete with manual and motor driven operating mechanism.
 - (vi) Two numbers, 3150A, 3 - phase, single pole, group operated Safety Grounding Switches complete with manual and motor driven operating mechanism

- (vii) One number, 3– phase, High Speed Fault Make Grounding Switches, complete with group operated manual and motor driven operating mechanisms
- (viii) Three numbers single phase or three phase SF6 Ducts and Gas Insulated Terminal Connection (SF6) for connecting overhead conductors to complete Line Bay Module
- (ix) Gas Ducts with Gas Monitoring Devices, Barriers, Pressure Switches, UHF PD sensor etc., as required.
- (x) Local Control Cubicle.

- SF6 gas insulated bus (GIB) ducts including support structures from outside the GIS Building to SF6 to Air Bushing as per layout. It shall be complete with all necessary SF6 gas filling, gas monitoring equipment and gas barrier, pressure switch, UHF PD sensor etc. The SF6 gas duct inside GIS are part of GIS module.
- SF6 to Air bushing along with support structure for outdoor connection to connect GIS with Power Transformer and OHL line and to MRSS metering yard.
- The Switchgear shall be complete with all necessary Terminal Boxes, SF6 Gas Filling, interconnecting Power and Control Wiring, Pressure Switches, Grounding Connections, Gas Monitoring Equipment and Piping (wherever applicable), Support Structures etc. SF6 Gas Filling and Evacuating Plant with Gas Cylinders shall be supplied by the Bidder as per Bill of Material and shall be utilized by the Bidder for commissioning. The Bidder would be required to hand over the same in good working condition with enough Gas for one charging of complete system with 20 % extra Gas as indicated in Mandatory Spares.
- Refer Part-2 of this Technical specification for detailed Specification of 220kV GIS.

33kV Outdoor Switchyard:

The 33 kV, 50 Hz, Short Circuit Current Rating of 31.5 kA for 3sec, Outdoor Switchyard with Single main & Transfer Bus Bar Arrangement with 6 numbers of Bays (1 number - Transformer Bay, 2nos Line Bays, 2nos Station transformer bays and 1 Transfer Bus coupler bay). Circuit Breaker shall be Outdoor VCB, CTs, PTs, and LAs for the 33kV System shall be as per PSLD attached in this document.

Power Transformer:

20 MVA, 220 / 33 kV Power Transformer:

One no. 20MVA, STAR/STAR, 220/33kV, 3-phase, 50Hz., Z(P-S)= 12.5%, oil immersed power transformer complete with +10% to -10% OLTC taps on 220kV side in steps of 1.25%, 220kV, & 33kV bushings, cable compartments, bushing current transformers and all other accessories and appurtenances.

The transformer is normally energized from 220kV side and it shall not saturate at 120% of nominal voltage. The inrush current shall not cause miss-operation of the protective relays and trip the transformer during energization. Inspection cover shall be provided in the main tank bottom near the OLTC selector switch side. **The Transformer Overloading capability should be as per IEC 60076-7 (i.e. 1.3 p.u.)** refer Part-4 power transformer technical specification for detailed Specification.

Notes:

1. Rail track with foundation shall be provided on the Transformer foundation, upto and

along the road.

2. The transformers shall be designed based on 55°C ambient temperature.

Station Service Transformer:

Two (2) nos., 250kVA, 33kV/400-230V, Dyn11, Z (P-S) = 4.5% ONAN station service transformers, all appurtenances and accessories shall be provided. The transformers shall be designed based on 55 deg C ambient temperature.

Surge Arresters

a. 220kV Surge Arresters:

Lot: 216kV Station Class, outdoor type metal oxide Surge Arresters, Complete with all clamps, connectors and steel supporting structures required for as per SLD attached in Tender drawings.

Gantries and Termination Hardware:

- i. Lot: Latticed Steel gantries and all the materials required for connecting 220kV & 33kV overhead Gantry conductors to Surge arresters, termination hardware, clamps, connectors etc., at OPTCL substation for six (2) nos. 220kV overhead line feeders and 33kV switchyard as per OPTCL standard drawings drawings.

HV Power Cabling & Terminations:

a. 220kV Power Cable:

220kV, Single core, Copper, XLPE cable to connect MRSS substation from 220KV Substation for Outgoing feeder. The minimum size of the cable shall be single core 1000mm² Copper conductor, XLPE cables per phase. The length of cable required shall be 750m (approx.) based on the layout proposed. Refer to the Tender drawings for plan layout. **The 220kV Cable shall be supplied by TFL, however its laying and termination (including its supply) shall be in the scope of the successful bidder.**

b. Bonding and Grounding of Cables

The 220kV & 33kV cables shall be single point bonded. The 220kV cables shall be checked for bonding configuration adequacy and sheath voltage limiter, which shall be provided. The CONTRACTOR shall furnish calculations for COMPANY review/approval. Link box arrangements shall be provided for 220kV system cables. CONTRACTOR shall furnish sheath isolation arrangement for the cable as required.

Note:

- i. All cable terminations and joints should be performed by manufacturer certified terminator/jointer or SEC certified for the corresponding voltages.
- ii. All cable terminations and joints should be performed under strict supervision of terminations and joints manufacturer.
- iii. Terminations and joints manufacturer should issue certificate in writing to OPTCL about 100% compliance to the manufacturer procedure along with verified check list & as-built drawings.
- iv. Each cable termination/joint must be installed by a qualified and certified jointer.
- v. Quality certificate (check sheet) for each single cable termination/joint must be filled and

signed by the jointer.

- vi. The contractor must insure in writing to Owner that the Cable Accessories stored are as per the manufacturer recommendation.

AC Auxiliary Power Supply:

415V, 3Ø and 230V 1Ø AC power supply system conforming to OPTCL standards with auto transfer scheme system, AC main distribution boards, sub-distribution panel boards complete with breakers, wires/cables, conduits, trays, etc. The AC main and sub distribution boards shall be sized for ultimate configuration of the substation and shall have minimum 20% spare feeder excluding the feeders reserved for future use.

Suitable change over switch and accessories shall be provided to connect minimum 250kVA, 415V, 3phase generator to feed the Substation lights, battery charger etc., during shutdown/blackout.

Contractor shall provide 415V, 3Ø, 4wire, out door type Power supply outlets with MCCB control suitably positioned to cover the 220kV Transformer for the purpose of connecting oil filter plant.

Contractor shall provide 415V, 3Ø, 4wire, outdoor type Power supply outlet with MCCB at the gas filling ports of outdoor GIBs connected to the various equipment. Capacity of power plug shall be suitable for connecting the gas filter plant. Refer Part-10 of this specification for detailed Specification.

Note: LVAC Auto transfer scheme shall be integrated with SAS for monitoring the status.

All 220V support Insulators (if applicable) shall be interchangeable.

The AC auxiliary system shall be designed for the ultimate configuration of the substation taking into consideration the optional work and future as well.

DC Auxiliary Power Supply (220V & 48V DC):

The Capacity of Battery and Battery Chargers shall be installed as per the capacity provided by the owner, with main DC distribution board, sub-distribution panel boards complete with breakers, wires/cables, conduits, trays, etc. The DC main and sub distribution boards shall be sized for ultimate configuration of the substation and shall have minimum 20% spare feeders excluding the feeders reserved for future use.

OPTCL has an apprehension that the DC cabling network of 220/33KV GIS SS may have a DC cable capacitance near to or exceeding the 10 micro Farad, limit permissible to avoid the possibility of mal tripping of certain protective relays (especially lockout relays) due to DC cable capacitance discharge during a DC cable / wiring ground fault.

The contractor shall make calculation of DC cable capacitance before laying the same and accordingly shall take necessary measures to avoid the possibility of mal-operation of relays.

The CONTRACTOR shall take necessary measurements, after completion of the Project; in presence of OWNER representatives to have a record of the actual DC cable capacitance of DC auxiliary power cabling systems. No outage on the substation will be permitted for taking these measurements and the CONTRACTOR shall take these measurements by using necessary instruments capable of taking on-line measurements of cable capacitance (like Battery Ground fault locator of reputed makes). Crosschecking of the measured value with approximate estimated values based on the cable sizes and length in the system shall also be done. The measurement method and obtained Result details (values in μF) shall be submitted as part of Final Documents Submittal.

Metering functions and alarms of DC auxiliary power system shall be integrated with SAS.

Lighting System and Small Power Requirements:

Indoor & outdoor lighting including security fence lighting, area lighting, emergency lighting system, fixtures, supports, switches, light control devices, receptacles, conduits, trays, and wiring required to complete the lighting system installation in accordance with OPTCL Engineering Standards.

Grounding System:

Grounding system with grounding conductors, ground rods and other associated accessories complete shall be in accordance with OPTCL Engineering Standard.

SAS / CONTROL AND PROTECTIVE RELAYING REQUIREMENTS

CONTROL SYSTEM:

The CONTRACTOR shall provide a complete modern advanced Substation Automation System (SAS) for the 220kV and 33kV systems. The panels for the same shall conform to OPTCL material standards as applicable. The Monitoring, control and Protection system shall be IEC 61850 Standards based Substation Automation System (SAS).

The following control levels shall be provided for the 220kV, and 33kV substation equipment:

- a. Local Controls at bay levels from BCU, BCPU and LCC and Station Control facilities with all required items.
- b. Supervisory control from SAS (Power Control Center).
- c. Remote Control from the station HMI and Power Control Center.
- d. The Contractor shall provide integral control system along with the 33kV Protection Panels in accordance with OPTCL standards. Normally 33kV switchyard will be controlled through SAS. Manual control will also be possible with the selector switch provided in the switchgear.

Remote Tap Changer Control (RTCC) Panel:

Digital RTCC panel shall be provided for 220/33kV, 20MVA transformer, conforming to OPTCL Engineering Standard. The RTCC scheme shall be integrated to the Substation Automation System (SAS).

SAS / Local / Emergency Closing Synchro checking and Synchronizing System:

a. SAS / Local Closing Synchro check:

The CONTRACTOR shall provide the synchro check scheme for SAS/Local closing for all 220/33kV CBs in OPTCL S/S, under all control levels specified under Control System above. The System shall use the BCU, BCPU (for 33kV) synchro check function as part of the SAS Structure. The system should provide a successfully operating synchro checking/synchronizing system for all present and future bays.

b. Emergency Closing Synchro check:

The CONTRACTOR shall provide an Emergency synchro check scheme to provide Manual closing during BCU and/or SAS failure for all 220/33kV CBs in OPTCL S/S, under control level 'a' specified under Control System above. All equipment/engineering necessary to facilitate a properly functioning emergency synchro checking/synchronizing system for all present and future bays is part of the scope.

Contractor can choose to apply any of the below options as an Emergency Closing Synchro check Scheme:

- 1- A separate synchro check relay for each voltage level (220/33kV) to facilitate closing CBs from the LCC Mimic Board. Adequate Synchro scope sets should be provided for observing the synchronism status during the CB closing (with or without synchro check

relay). Contractor should provide all required equipment/engineering to facilitate a properly functioning emergency synchro checking/synchronizing scheme for OPTCL review and approval.

- 2- In case the BCU employed (OPTCL approved) and associated systems/accessories are fully capable of providing backup synchro checkscheme for another one (1) bay, Contractor can provide the Emergency Synchro check Scheme using a BCU separate backup synchro checkfunction/scheme for closing neighboring bay CB in case that bay's BCU fails. All bays should be covered, and each bay should be covered by a different neighboring BCU. Adequate Synchro scope sets should be provided for observing the synchronism status during the CB closing(with or without synchro check relay). Contractor should provide all required equipment/engineering to facilitate a properly functioning emergency synchro checking/synchronizing scheme for OPTCL review and approval.

PROTECTIVE RELAYING:

The CONTRACTOR shall provide the Protection requirements as per CONTROL AND RELAY PANEL Technical Specification.

ELECTRICAL SYSTEM INTERLOCKING:

The CONTRACTOR shall provide and install all applicable electrical equipment interlocking requirements in accordance with OPTCL Standards. The SAS Interlocks, utilizing hard wired interlocks in series with software interlocks shall be provided.

ALARM/ANNUNCIATOR REQUIREMENTS:

At OPTCL 220/33KV GIS S/S, the Annunciator system shall be part of SAS smart system with prevailing state of the art technology. The list of alarms to be provided shall be as per SAS Technical Specification. The Alarm/Annunciator functional requirements shall be integrated into the Substation Automation System (SAS).

All LCC panels of 220kV GIS shall have annunciator modules installed as per Standards.

FIBRE OPTIC TERMINAL EQUIPMENT:

Fibre Optic Terminal Equipment (STM - 1 SDH / Multiplexer) shall be supplied and installed by the bidder to provide Speech, Data and Tele Protection Applications. Specification of FOTE is enclosed separately this specification.

VISUAL MONITORING SYSTEM & FIRE FIGHTING SYSTEM:

.For Visual Monitoring System and Fire Fighting System requirements, shall be as per detailed Technical Specification.

CIVIL AND STRUCTURAL WORK:

The Work shall include but not limited to the following:

- (i) Geotechnical Soil Investigation including measurement of Earth Resistivity
- (ii) Contouring and Sub Station Levelling
- (iii) Development of Land for entire Sub Station including Future provision and if required RCC Retaining / Protection Walls
- (iv) Boundary Wall along the Employer's Property Line with Main Gate and Security Check Post. Internal fence height of 1.8 metres, Half / Full Masonry Wall at average distance of 2.5 metres is to be constructed and Bidder may quote the Unit Running Metre (RM) Rate.
- (v) Design, Engineering and Civil Work to withstand Earthquake in Zone – III:

- (a) Buildings for Control Room and GIS Halls and Associated LCC / Relay / FOTE Rooms. The GIS Hall shall be suitable for mounting EOT Crane and the requirement of Crane shall be as per Section project. The GIS and Control Room Building shall have space provision for adding Future Bays and Jointing Plugs required for connecting GIS of different Makes and Associated Local Control Panels, Control Cables, all Consumable and Hardware etc.
- (b) All Civil Works including Foundations associated with Erection of SF6 Gas Insulated Metal Enclosed Switchgear along with its SF6 Ducts and SF6 / Air Bushings
- (c) Foundation for Bus Duct Supporting Structures, GIS (SF6 / Air) Bushing, Lighting Poles, Panels and Control Cubicles of Equipment wherever required
- (d) All civil works including foundation for outdoor 33kV equipment, Tower, Cable trench in 33kV yard.
- (e) Foundations for Equipment, and Lightning protection cum Lighting Mast as per approved DSLP design & drawing.
- (f) Cable Trenches in the Switchyard and inside GIS Halls and Associated LCC / Relay and Control Room Building.
- (g) Stone Spreading and Anti Weed Treatment including PCC.
- (h) Permanent Water Supply for Control Room and GIS Building, suitable from nearby water source/bore well.
- (i) Fire Hydrant Pipe to cover the GIS Building and yard for the firefighting system. Fire Alarm System for the GIS Building and Control Building.
- (j) Approach and Main Road to the Sub Station Site and all periphery Roads including Culverts.
- (k) Fencing and Gates for Sub Station Area
- (l) Rain Water Harvesting in Sub Station Area
- (m) Drainage System in the Sub Station Area
- (n) Foundations of 1 no., 20MVA, Three Phase 220/33kV power Transformers along with Jacking Pads and Pylon Supports, Rail Cum Road and Fire Resistant Wall if required.
- (o) Sewerage Work, Oil Sump and Soak Pit (having 100 % Transformer Oil Capacity), and Septic Tanks, requisite Water Facilities, Owner's Office and Stores etc.,
- (p) Construction of Overhead Water Tank to meet the requirement for Control Room cum GIS and Deluge valve room Building for Transformers firefighting protection.
- (q) Any other Work specifically not mentioned but that may be required for completion of the Scope of Work

Before proceeding with the Construction Work of the Sub Station, the Bidder shall fully familiarize himself with the Site Conditions, General Arrangements, and Scheme etc. Though the Owner shall endeavour to provide the information, it shall not be binding for the Owner to provide the same. The Bidders are advised to visit the Substation Site and acquaint themselves with the topography, infrastructure, and the design philosophy. The Bidder shall be fully responsible for providing all Equipment, Materials, System, and Services specified or otherwise which are required to complete the construction and successful commissioning, operation and maintenance of the Sub Station in all respects. All Materials required for the Civil Construction / Installation Works shall be supplied by the Bidder. The cement and steel shall also be supplied by the Bidder.

The Bidder shall also be fully responsible for:-

- (i) Overall Coordination with Internal / External Agencies
- (ii) Training of Owner's Manpower
- (iii) Loading, Unloading, Handling, Moving to final destination for successful Erection, Testing and Commissioning of the Sub Station
- (iv) The supply and installation Metal Oxide Surge Arrestors, Parameters, Location for complete Switchyard as per Insulation coordination study provided by the owner.

- (v) Fire Protection of Transformer as per CBIP Manual.
- (vi) Fire Resistant Walls between Transformer Units
- (vii) The Bay Control Unit (BCU), Bay control Protection Unit (BCPU), Sub Station Automation System, Relay and Protection Panels for 220kV and 33kV system and Local Control Cubicle (LCC) shall be accommodated in Air Conditioned environment.
- (viii) Transportation and Delivery of the entire Equipment / Material covered under the Scope of Work at Sub Station Site. Temporary strengthening of Bridges in order to transport the Equipment / Material and widening of roads if required is in the Scope of the Bidder.
- (ix) Provision of Electrical and Water Connections required during the Construction of the Sub Station is covered in the Scope of the Bidder and the Owner will not provide the same.

Any other Items not specifically mentioned in the Specification which are required for Erection, Testing and Commissioning for satisfactory Operation of the Sub Station are deemed to be included in the Scope of the Specification and the same shall be supplied and erected by the Bidder.

The Bidder shall arrange all T & P (such as crane, Ladder and Platforms etc.,) required for Erection, Testing, and Commissioning of the System at his own cost. Further, all consumables, wastage and damages shall be to the account of the Bidder.

The Civil Works suitable (Earthquake of Zone – III) to be provided by the Bidder shall include the following Major Items:-

GIS HALL AND CONTROL ROOM:

Plinth Level of Control Room shall be 0.50 metre above FGL, height of each floor shall be minimum 4.50 meters, The Size of the Rooms shall be as per mentioned in the “Civil Works” specification. However bidder shall calculate the building sizes according to the requirement of GIS dimensions, CRP dimensions and additional area for operation and maintenance requirement.

The detail Structural, architectural and constructional design drawings shall be submitted by the successful bidder to the owner for approval prior to the construction.

PROJECT INTERFACE:

This section describes the scope of work of the various agencies/contracts involved in this PROJECT at the construction interface points between various CONTRACTORS.

WORK to be done by GIS S/S CONTRACTOR:

Coordinate all WORK and construction interface activities with all other Contractor(s)/Agencies and OWNER as necessary for successful completion of all interface activities by other agencies.

The Successful bidder shall carryout the following work, at 220/33kV S/S but not limited to:

- a. Supply the necessary hardware and terminate the jumper conductors to the 220kV Substation equipment. The jumper conductors, insulators and all hardware & fittings.
- b. Design, fabricate and erect all latticed steel 220kV gantry structures as shown in Layout. Coordinate with the OHTL contractor(s) for the position & height of gantry, conductor and OPGW/OGW loadings etc. to be used in the design of the take-off structures.
- c. Supply and install two (2)-50mm diameter PVC coated galvanized steel conduit from the Fiber Optical cable joint boxes at the proposed take-off structures up to the nearest communication hand hole located.
- d. Provide and install necessary cable trays/cable ladder/raceways for routing of the Under Ground

Non-metallic Fiber Optic Cable inside the communication room.

- e. Provide and install Optical Fiber Management Rack, optical patch cord, optical pigtail cables, splice the optical pigtail cables and complete the termination of the optical fiber cables on SDH fiber optic equipment and test each loop from end-to-end as per OPTCL requirement for all links.
- f. End to end testing of the complete fiber optic cable after SDH and Medium Density fiber optic Terminal equipment installed and coordinate with T/L contractor for the commissioning of T/Ls and CABLEs.
- g. Coordinate all WORK activities regarding optical fiber cable installation and testing with the OWNER REPRESENTATIVE.
- h. Coordinate with the OHTL's Contractor for the protection, end to end testing and commissioning of the OHTL.

The CONTRACTOR shall extend all cooperation and coordination of construction interface activities with other CONTRACTOR / Agencies and OWNER as necessary for successful completion of their work.

STANDARDS:

Except where otherwise specified or implied, the Contract Works shall comply with the latest edition of the relevant Indian Standards, International Electro technical Commission (IEC) standards and any other standards mentioned in this Specification. The Contractor may submit for approval, equipment or materials conforming to technically equivalent National Standards. In such cases copies of the relevant Standards or part thereof, in the English language shall be submitted with the Tender. In case of conflict the order of precedence shall be (1) IEC, (2) IS and (3) other alternative standard.

Reference to a particular standard or recommendation in this Specification does not relieve the Contractor of the necessity of providing the Contract Works complying with other relevant standards or recommendations.

The list of standards provided in the schedules of this Specification is not to be considered exhaustive and the Contractor shall ensure that equipment supplied under this contract meets the requirements of the relevant standard whether or not it is mentioned therein.

SECTION V - EQUIPMENT/MATERIALS AND TECHNICAL SPECIFICATIONS:

GENERAL:

This Section outlines broadly the technical specifications of the major equipment/ materials required for the complete installation of the PROJECT. The specifications outlined herein shall be read in conjunction with the attached PROJECT drawings, the COMPANY Material Standard Specifications and the associated International Standards and Codes. The ratings and specific requirements of various electrical equipment shall be as indicated in Data Schedule of COMPANY Material Standard Specifications, and the CONTRACTOR shall ensure full conformity with the same.

Bolts and nuts:

All bolts, studs, screw threads, pipe threads, bolt heads and nuts shall comply with the appropriate national standards for metric threads, or the technical equivalent.

Except for small wiring, current carrying terminal bolts or studs, for mechanical reasons, shall not be less than 6 mm in diameter.

All nuts and pins shall be adequately locked.

Wherever possible bolts shall be fitted in such a manner that in the event of failure of locking resulting in the nuts working loose and falling off, the bolt will remain in position.

All bolts, nuts and washers placed in outdoor positions shall be treated to prevent corrosion, by hot dip galvanising or electro galvanising to service condition 4. Appropriate precautions shall be taken to prevent electrolytic action between dissimilar metals.

Where bolts are used on external horizontal surfaces where water can collect, methods of preventing the ingress of moisture to the threads shall be provided.

Each bolt or stud shall project at least one thread but not more than three threads through its nut, except when otherwise approved for terminal board studs or relay stems. If bolts and nuts are placed so that they are inaccessible by means of ordinary spanners, special spanners shall be provided.

The length of the screwed portion of the bolts shall be such that no screw thread may form part of a shear plane between members.

Taper washers shall be provided where necessary.

Protective washers of suitable material shall be provided front and back on the securing screws.

Galvanizing:

General:

All machining, drilling, welding, engraving, scribing or other manufacturing activities which would damage the final surface treatment shall be completed before the specified surface treatment is carried out.

Galvanizing:

All metal surfaces shall be subjected to treatment for anti-corrosion protection. All ferrous surfaces for external use shall be hot dip galvanised. High tensile steel nuts, bolts and spring washers shall be electro galvanised to service condition 4. All steel conductors including those used for earthing and grounding (above ground level) shall also be galvanised according to IS 2629.

All galvanising shall be applied by the hot dip process and shall comply with IS 2629, IS 2633, IS 4759, IS 1367 or IS 6745.

All welds shall be de-scaled, all machining carried out and all parts shall be adequately cleaned prior to galvanising. The preparation for galvanising and the galvanising itself shall not adversely affect the mechanical properties of the coated material.

The threads of all galvanised bolts and screwed rods shall be cleared of spelter by spinning or brushing. A die shall not be used for cleaning the threads unless specially approved by the Engg. Incharge (Divisional Engr.). All nuts shall be galvanised with the exception of the threads which shall be oiled. Surfaces which are in contact with oil shall not be galvanised or cadmium plated.

Partial immersion of the work will not be permitted and the galvanising tank must therefore be sufficiently large to permit galvanising to be carried out by one immersion.

Galvanising of wires shall be applied by the hot dip process and shall meet the requirements of IS 2141.

The minimum weight of the zinc coating shall be 610 gm/sq.m and minimum thickness of coating shall be 86 microns for all items thicker than 5 mm. For items of less than 5 mm thickness requirement of coating thickness shall be as per BS 729. For surface which shall be embedded in concrete, the zinc coating shall be a minimum of 800 gm/sq.m.

The galvanised surfaces shall consist of a continuous and uniform thick coating of zinc, firmly adhering to the surface of steel. The finished surface shall be clean and smooth and shall be free from defects such as discoloured patches, bare spots, unevenness of coating, spelter which is loosely attached to the steel globules, spiky deposits, blistered surface, flaking or peeling off, etc. The

presence of any of these defects noticed on visual or microscopic inspection shall render the material liable to rejection.

After galvanising no drilling or welding shall be performed on the galvanised parts of the equipment excepting that nuts may be threaded after galvanising. Sodium dichromate treatment shall be provided to avoid formation of white rust after hot dip galvanisation.

The galvanised steel shall be subjected to six one minute dips in copper sulphate solution as per IS 2633.

Sharp edges with radii less than 2.5 mm shall be able to withstand four immersions of the Standard Preece test. All other coatings shall withstand six immersions. The following galvanising tests should essentially be performed as per relevant Indian Standards.

- Coating thickness
- Uniformity of zinc
- Adhesion test
- Mass of zinc coating

Galvanised material must be transported properly to ensure that galvanised surfaces are not damaged during transit. Application of zinc rich paint at site shall not be allowed.

Cleaning, painting and tropicalisation:

General:

All paints shall be applied in strict accordance with the paint manufacturer's instructions.

All painting shall be carried out on dry and clean surfaces and under suitable atmospheric and other conditions in accordance with the paint manufacturer's recommendations.

An alternative method of coating equipment such as with epoxy resin-based coating powders will be permitted, subject to the approval of the Engg. Incharge (Divisional Engr.), and such powders shall comply with the requirements of IEC 455. The Contractor shall provide full details of the coating process to the Engg. Incharge (Divisional Engr.) For approval.

It is the responsibility of the Contractor to ensure that the quality of paints used shall withstand the tropical heat and extremes of weather conditions specified in the schedules. The paint shall not peel off, wrinkle, be removed by wind, storm and handling on site and the surface finish shall neither rust nor fade during the service life of the equipment.

The colours of paints for external and internal surfaces shall be in accordance with the approved colour schemes.

Works painting processes:

All steelworks, plant supporting steelworks and metalwork, except galvanized surfaces or where otherwise specified, shall be shot blasted to BS 7079 or the equivalent ISO standard. All sheet steel work shall be degreased, pickled, phosphated in accordance with the IS 6005 "Code of Practice for phosphating iron and sheet steel". All surfaces shall then be painted with one coat of epoxy zinc rich primer, two pack type, to a film thickness of 50 microns. This primer shall be applied preferably by airless spray and within twenty minutes but not exceeding one hour of shot blasting.

All rough surfaces of coatings shall be filled with an approved two pack filler and rubbed down to a smooth surface.

The interior surfaces of all steel tanks and oil filled chambers shall be shot blasted in accordance with BS 7079 or the equivalent ISO, and painted within a period of preferably twenty minutes, but not exceeding one hour with an oil resisting coating of a type and make to the approval of the Engg. Incharge (Divisional Engr.).

The interior surfaces of mechanism chambers, boxes and kiosks, after preparation, cleaning and priming as required above, shall be painted with one coat zinc chromate primer, one coat phenolic based undercoating, followed by one coat phenolic based finishing paint to a light or white colour. For equipment for outdoor use this shall be followed by a final coat of anti-condensation paint of a type and make to the approval of the Engg. Incharge (Divisional Engr.), to a light or white colour. A minimum overall paint film thickness of 150 microns shall be maintained throughout.

All steelworks and metalwork, except where otherwise specified, after preparation and priming as required above shall be painted with one coat metallic zinc primer and two coats of micaceous iron oxide paint followed by two coats of either phenolic based or enamel hard gloss finished coloured paint to the approval to an overall minimum paint film thickness of 150 microns.

Galvanised surfaces shall not be painted in the works.

All nuts, bolts, washers etc., which may be fitted after fabrication of the plant shall be painted as described above after fabrication.

The painted metal works shall be subjected to paint qualification test as per draft ANSI/IEEE-Std 37.21 -1985 clause 5.2.5.

Site painting:

After erection at site, the interior surfaces of mechanism chambers and kiosks shall be thoroughly examined, and any deteriorated or mechanically damaged surfaces of such shall be made good to the full Specification described above.

After installation/erection at site all surfaces of steelworks and metalwork shall be thoroughly washed down. Any deteriorated or otherwise faulty paint-work removed down to bare metal and made good to the full Specification described above, then painted one further coat of phenolic based undercoating and one coat phenolic based hard gloss finishing paint to provide an overall minimum paint film thickness of 200 microns.

Any nuts, bolts, washers, etc., which have been removed during site erection, or which may be required to be removed for maintenance purposes shall be restored to their original condition.

All paint work shall be left clean and perfect on completion of the works.

Colour Schemes The Contractor shall propose a colour scheme for the substation for the approval of Engg. Incharge (Divisional Engr.). The decision of Engg. Incharge (Divisional Engr.) Shall be final. The scheme shall include:

- Finishing colour of indoor equipment
- Finishing colour of outdoor equipment
- Finish colour of all cubicles
- Finishing colour of various auxiliary system equipment including piping.
- Finishing colour of various building items.

All steel structures, plates etc. shall be painted with non-corrosive paint on a suitable primer. It may be noted that normally all Employer's electrical equipment in Employer's switchyard are painted with shade 631 of IS:5 and Employer will prefer to follow the same for this project also. All indoor cubicles shall be of same colour scheme and for other miscellaneous items colour scheme will be subject to the approval of the Engg. Incharge (Divisional Engr.).

Sl. No.	Equipment	Application Environment	
		Indoor	Outdoor

		Colour	Code IS:5	Colour	Code IS:5
220kV Class Equipment					
1	Transformers	—	—	Light grey	631
2	Marshalling boxes, CTs, PT's, CVT's, surge counter casings, junction boxes etc.	Light Admiralty grey.	697	Light Admiralty grey.	697
3	Control and relay panels, PLCC cabinets etc.	Smoke grey	692	—	—
4	Porcelain parts i.e. insulators	Dark brown	412	Dark brown	412
5	All structures/ metallic parts exposed to atmosphere	Hot dip galvanized			
33kV Class equipment					
6	Switchgear cubicles	Smoke grey	692	Light grey	631
7	Control and relay panels	Smoke grey	692	—	—
	LT switchgear				
8	LT switchgear exterior	Smoke grey	692	Light grey	631
9	ACDB/ MCC	Smoke grey	692	Light grey	631
10	DCDB	Smoke grey	692	—	—
11	LT bus duct in side enclosure	Matt Paint		—	—
12	LT bus duct outside enclosure	Smoke grey	692	—	—
13	Motors	Smoke grey	692	Light grey	631
14	Diesel generator engine	Smoke grey	692	—	—
15	Diesel generator	Smoke grey	692	—	—
16	LT transformers	Smoke grey	692	Light grey	631
17	Battery charger	Smoke grey	692	—	—
18	Mimic diagram				
	400kV	Dark violet	796	—	—
	220kV	Golden yellow	356	—	—
	132kV	Sky blue			
	33kV	Signal red	101	—	—
	11kV	Canary yellow	537	—	—
		Middle brown	309	—	—

	415V		411	—	—
	Miscellaneous				
19	Control modules and console inserts	Smoke grey	692	Light grey	631
20	Lighting package equipment outside	Light grey	631	Light grey	631
21	Lighting package equipment inside	Glossy white		Glossy white	
22	Water pipes	sea green	217	sea green	217
23	Air pipes	Sky blue	101	Sky blue	101
24	Transformer oil pipes	Light brown	410	Light brown	410
25	Fire Installations	Fire red	536	Fire red	536
26	Insulating oil/ gas treatment plant	Gulf red	473	Gulf red	473

Table: Recommended colour schemes

Provision for exposure to hot and humid climate:

Outdoor equipment supplied under the Specification shall be suitable for service and storage under tropical conditions of high temperature, high humidity, heavy rainfall and environment favourable to the growth of fungi and mildew. The indoor equipment located in non-air-conditioned areas shall also be of same type.

Anti-condensation Provisions:

Space heaters where provided shall be suitable for continuous operation at 240V supply voltage. On-off switch and fuse shall be provided.

One or more adequately rated permanently or thermostatically connected heaters shall be supplied to prevent condensation in any compartment. The heaters shall be installed in the lower portion of the compartment and electrical connections shall be made from below the heaters to minimise deterioration of supply wire insulation. The heaters shall be suitable to maintain the compartment temperature at approximately 10C, above the outside air temperature to prevent condensation. This shall be demonstrated by tests.

Fungistatic treatment:

Besides the space heaters, special moisture and fungus resistant varnish shall be applied to parts which may be subjected or predisposed to the formation of fungi due to the presence or deposit of nutrient substances. The varnish shall not be applied to any surface or part where the treatment will interfere with the operation or performance of the equipment. Such surfaces or parts shall be protected against the application of the varnish.

Ventilating specifications

In order to ensure adequate ventilation, compartments shall have ventilation openings provided with fine wire mesh of brass or galvanised steel to prevent the entry of insects and to reduce to a minimum the entry of dirt and dust. Outdoor compartment openings shall be provided with shutter type blinds.

Labels and plates:

All apparatus shall be clearly labelled indicating, where necessary, its purpose and service positions. Each phase of alternating current and each pole of direct current equipment and connections shall be coloured in an approved manner to distinguish phase or polarity.

The material of all labels and the dimensions, legend, and method of printing shall be to approval. The surface of indoor labels shall have a matt or satin finish to avoid dazzle from reflected light.

Colours shall be permanent and free from fading. Labels mounted on black surfaces shall have white lettering. 'Danger' plates shall have red lettering on a white background.

All labels and plates for outdoor use shall be of non-corroding material. Where the use of enamelled iron plates is approved, the whole surface including the back and edges, shall be properly covered and resistant to corrosion. Protective washers of suitable material shall be provided front and back on the securing screws.

Labels shall be engraved in Hindi, English and Oriya. Name plates shall be white with black engraved lettering and shall carry all the applicable information specified in the applicable items of the Standards.

Any other relevant information which may be required for groups of smaller items for which this is not possible e.g. switch bays etc. a common name plate in Oriya with the title and special instructions on it shall be provided.

No scratching, corrections or changes will be allowed on name plates.

All equipment mounted on front and rear sides as well as equipment mounted inside the panels shall be provided with individual name plates with equipment designation engraved.

On the top of each panel on front as well as rear sides large name plates with bold size lettering shall be provided for circuit/ feeder/ cubicle box designation.

All front mounted equipment shall be also provided, at the rear, with individual name plates engraved with tag numbers corresponding to the one shown in the panel internal wiring to facilitate tracing of the wiring. The name plates shall be mounted directly by the side of the respective equipment wiring.

Name plates of cubicles and panels may be made of non-rusting metal or 3 ply lamicoide. These name plates may be black with white engraved lettering.

The name plate inscription and size of name plates and letters shall be submitted to the Engg. Incharge (Divisional Engr.)/Engineer for approval.

The nameplates of the apparatus shall include, at least, the information listed below, together with any other relevant information specified in the applicable standards:

- Concise descriptive title of the equipment
- Rating and circuit diagrams
- Manufacturer's name, trade-mark, model type, serial number
- Instruction book number
- Year of manufacture
- Total weight (for capacitor racks indicate weight, for capacitors indicate quantity of liquid)
- Special instructions, if any, about storage, transportation, handling etc.

Each measuring instrument and meter shall be prominently marked with the quantity measured e.g.

kV, A, MW etc. All relays and other devices shall be clearly marked with manufacturers name, manufacturer's type, serial number and electrical rating data.

Danger plates and plates for phase colours shall be provided as per requirement. The Contractor shall devise a system to designate equipment and sub-systems. The nameplates/labels displaying these designations shall be installed at appropriate locations. Whenever motion or flow of fluids is involved, plates showing direction of motion or flow shall also be provided.

Padlocks:

For each item of plant the Contractor shall provide a pad lockable handle and a nonferrous padlock with different key changes in order to prevent access to control cabinets, cubicles and relay panels. The Contractor shall provide two keys for each lock and a master key for each substation.

Cabinets for the accommodation of padlocks and keys, whilst not in use, shall be provided and shall be suitably labelled so that keys will be readily identifiable.

Earthing:

Metal parts of all equipment other than those forming part of an electrical circuit shall be connected directly to the main earth system via two separate conductors of adequate capacity at two different points.

All main members of structural steelworks shall be earthed by galvanised iron flat connections bonded by welding or bolting to the steelworks.

Connections to apparatus and structures shall be made clear of ground level, preferably to a vertical face and protected as appropriate against electrolytic corrosion. They shall be made between clean surfaces and of sufficient size and pressure to carry the rated short circuit current without damage.

Earth bars installed directly into the ground should normally be laid bare and the trench back-filled with a fine top soil. Where the soil is of a hostile nature, special precautions must be taken to protect the earth bar, the method used being subject to the agreement of the Engg. Incharge (Divisional Engr.).

Joints in earth bars shall be welded and then coated with a suitable anti-corrosion protection treatment.

Facilities shall be provided on the earth bar run between equipment and the base of structures, comprising a looped strip, so as to permit the attachment of portable earth connections for maintenance purposes.

The cross sectional area of the earth bar and connections shall be such that the current density is not greater than 100 A/mm² for a 3 second fault duration.

Lubrication:

Bearings which require lubrication either with oil or grease shall be fitted with nipples.

PRODUCTION PROCESS REQUIREMENTS:

Castings:

General:

All castings shall be true to pattern, free from defects and of uniform quality and condition. The surfaces of castings which do not undergo machining, shall be free from foundry irregularities. The castings shall be subject to NDT, chemical, mechanical and metallographic tests. Details of the same shall be furnished to Engg. Incharge (Divisional Engr.) for review/approval. Magnetic particle inspection (MPI) test, wherever applicable, shall be carried out in longitudinal and transverse direction to detect radial and axial cracks.

Iron castings:

Iron casting material shall be in accordance with ASTM A 126 Class B. A copy of the ladle analysis shall be sent to the Engg. Incharge (Divisional Engr.). Each casting shall have a test bar from which tension test specimens may be taken. Test specimen shall be in accordance with ASTM A 370 and tested in accordance with ASTM E8. The Contractor shall submit his procedures for testing and acceptance for iron castings for approval by the Engg. Incharge (Divisional Engr.).

Steel castings:

Steel castings shall be manufactured in accordance with ASTM A 27 and shall be subjected to appropriate tests and inspection as detailed herein.

Copies of mandatory documentation, such as ladle analyses and mechanical test results, shall be sent to the Engg. Incharge (Divisional Engr.). (Non-ferrous casting material and castings shall be manufactured in accordance with the appropriate ASTM standards for the material concerned).

Forgings:

When requested by the Engg. Incharge (Divisional Engr.), forgings will be subjected to inspection in the regions of fillets and changes of section by suitable method. Magnetic particle, dye-penetration, radiographic or ultrasonic, or any combination of these methods may be used to suit material type and forging design.

The testing is to be carried out after the rough machining operation and is to be conducted according to the appropriate ASTM standards.

MPI test on forging shall be carried out to detect both radial and axial cracks. Ferrous forgings shall be demagnetised after such tests.

Any indentations which prove to penetrate deeper than 2.5% of the finished thickness of the forging shall be reported to the Engg. Incharge (Divisional Engr.) Giving location, length, width and depth. Any indentations which will not machine out during final machining shall be gouged out and repaired using an approved repair procedure.

Repair of rotating elements by welding will only be accepted subject to detailed examination of the proposal by the Engg. Incharge (Divisional Engr.) Prior to the repair being carried out.

The forging shall be tested for mechanical and metallographic tests as per ASTM. The details shall be mutually discussed/agreed upon.

Fabricated components:

All components machined or fabricated from plate, sheet or bar stock shall meet the material requirements of ASTM or material specification approved by the Engg. Incharge (Divisional Engr.)

Structural steel, rolled shapes, bars, etc. shall comply with the latest ASTM for A36.

Plate steel shall be of a designation and quality suitable for the function it is intended to perform. Insofar as it is compatible with its function, it shall comply with ASTM A283 structural quality.

All, or a representative number of such components, shall be subjected to one or more of the following tests: visual, dye penetration, magnetic particle (transverse and longitudinal), ultrasonic or radiographic. These tests shall be in accordance with the recommended practices of the ASTM. The terms of reference for acceptance shall be the applicable ASTM Specifications.

Welding and welders qualifications:

General:

All welding shall be carried out by qualified welders only.

All welding shall be in accordance with the corresponding standards of the American Welding Society or the American Society of Mechanical Engineers.

Other standards to determine the quality of welding process and qualifications of welders may be

considered, provided that sufficient information is first submitted for the approval of the Engg. Incharge (Divisional Engr.).

Prior to the start of fabrication, the Contractor shall submit to the Engg. Incharge (Divisional Engr.) For approval, a description of each of the welding procedures which he proposes to adopt, together with certified copies of reports of the results from tests made in accordance with these procedures.

The Contractor shall be responsible for the quality of the work performed by his welding organisation. All welding operators, to be assigned work, including repair of casting, shall pass the required tests for qualification of welding procedures and operators. The Engg. Incharge (Divisional Engr.) Reserves the right to witness the qualification tests for welding procedures and operators and the mechanical tests at the samples.

The Contractor shall bear all his own expenses in connection with the qualification tests. If the work of any operator at any time appears questionable, such operator will be required to pass appropriate pre-qualification tests as specified by the Inspector and at the expense of the Contractor.

Welding:

All welding shall be performed in accordance with the appropriate standards. The design and construction of welded joints subject to hydraulic pressure shall conform to the applicable requirement of ASME "Boiler and Pressure Vessel Code" shall be qualified in accordance with Section IX of this Code. The design and construction of welded joints not subjected to hydraulic pressure shall, as a minimum, conform to the requirements of AWS "Specification for Welded Highway and Railway Bridge" D2.0. Except for minor parts and items specifically exempted from stress relieving, all shop-welded joints shall be stress relieved in accordance with the requirements of the ASME "Boiler and Pressure Vessel Code" Section VIII.

In addition to satisfying the procedural and quality requirements set forth in the applicable code and/or these Specifications, all welding shall meet the following requirements for workmanship and visual quality:

- Butt welds shall be slightly convex, of uniform height and shall have full penetration.
- Fillet welds shall be of the specified size, with full throat and legs of equal length.
- Repairing, chipping and grinding of welds shall be done in a manner which will not gouge, groove or reduce the thickness of the base metal.
- The edges of the member to be joined shall expose sound metal, free from laminations, surface defects caused by shearing or flame-cutting operations or other injurious defects.

Welded joints subject to critical working stress shall be tested by approved methods of non-destructive testing, such as radiographic and ultrasonic examination, magnetic particle and liquid penetration inspection. All expenses in connection with these tests shall be borne by the Contractor. The extent of testing shall be as stipulated by the ASME "Boiler and Pressure Vessel Code", Section VIII, but without prejudice to the rights of the Inspector or the Engg. Incharge (Divisional Engr.) to ask for additional tests,

The arc-welding process to be used and the welding qualifications of the welders employed on the work shall be used in accordance with AWS requirements and Section VIII and IX of the ASME (American Society of Mechanical Engineers) Code, latest edition, as they may apply. All welding rods shall conform to the requirements of the latest issue of Section It, part C of the ASME Code.

Gas shielded welding (TIG or MIG) used as appropriate for aluminium, stainless steel or other material shall be carried out in accordance with the best commercial practice and the following standard specifications:

- Specifications for copper and copper-alloy welding rods (AWS A5.7, ASTM B259)

- Specification for corrosion-resisting chromium and chromium-nickel steel welding rods and bare electrodes (AWS A5.9, ASTM A371)
- Specifications for aluminium and aluminium alloy rods and bare electrodes (AWS A5.10, ASTM B285).
- Specifications for nickel and nickel-base alloy bare welding filler metal (AWS A5.14, ASTM B304).

Gas welding will not normally be used in the equipment. When a particular equipment manufacture requires the use of gas welding, the proposed process and the welder's qualification shall be in accordance with AWS B3.0.

Welding of galvanized components will not be allowed in the equipment.

Strict measures of quality control shall be exercised throughout the Equipment/ Works. The Engg. Incharge (Divisional Engr.) may call for an adequate NDT test of the work of any operator, who in his opinion is not maintaining the standard of workmanship. Should this NDT test prove defective, all work done by that operator, since his last test shall be tested at the Contractor's expense. If three or more of these tests prove defective, the operator shall be removed from the project.

A procedure for the repair of defects shall be submitted to the Engg. Incharge (Divisional Engr.) for his approval prior to any repairs being made.

Welding of pipes:

Before welding, the ends shall be cleaned by wire brushing, filing or machine grinding. Each weld-run shall be cleaned of slag before the next run is deposited.

Welding at any joint shall be completed uninterrupted. If this cannot be followed for some reason, the weld shall be insulated for slow and uniform cooling.

Welding shall be done by manual oxy-acetylene or manual shielded metal arc process. Automatic or semi-automatic welding processes may be done only with the specific approval of Engg. Incharge (Divisional Engr.).

As far as possible welding shall be carried out in flat position. If not possible, welding shall be done in a position as close to flat position as possible.

Downward technique is not allowed while welding pipes in horizontal position, unless permitted by the Engg. Incharge (Divisional Engr.).

Combination of welding processes or usage of electrodes of different classes or makes in a particular joint shall be allowed only after the welding procedure has been duly qualified and approved by the Engg. Incharge (Divisional Engr.).

No backing ring shall be used for circumferential butt welds.

Welding carried out in ambient temperature of 5°C or below shall be heat treated.

A spacer wire of proper diameter may be used for weld root opening but must be removed after tack welding and before applying root run.

Tack welding for the alignment of pipe joints shall be done only by qualified welders. Since tack welds form part of final welding, they shall be executed carefully and shall be free from defects. Defective welds shall be removed prior to the welding of joints.

Electrodes size for tack welding shall be selected depending upon the root opening.

Tack welds should be equally spaced.

Root run shall be made with respective electrodes/filler wires. The size of the electrodes shall not be greater than 3.25 mm (10 SWG) and should preferably be 2.3 mm (12 SWG). Welding shall be done with direct current values recommended by the electrode manufacturers.

Upward technique shall be adopted for welding pipes in horizontally fixed position. For pipes with wall thickness less than 3 mm, oxyacetylene welding is recommended.

The root run of butt joints shall be such as to achieve full penetration with the complete fusion of root edges. The weld projection shall not exceed 3 mm inside the pipe.

On completion of each run craters, weld irregularities, slag etc. shall be removed by grinding or chipping.

During the process of welding, all movements, shocks, vibration or stresses shall be carefully avoided in order to prevent weld cracks.

Fillet welds shall be made by shielded metal arc process regardless of thickness and class of piping. Electrode size shall not exceed 10 SWG. (3.25 mm). At least two runs shall be made on socket weld joints.

WIRING, CABLING AND CABLE INSTALLATION:

Cubicle wiring:

Panels shall be complete with interconnecting wiring between all electrical devices in the panels. External connections shall be achieved through terminal blocks. Where panels are required to be located adjacent to each other all inter panel wiring and connections between the panels shall be carried out internally. The Contractor shall furnish a detailed drawing of such inter panel wiring. The Contractor shall ensure the completeness and correctness of the internal wiring and the proper functioning of the connected equipment.

All wiring shall be carried out with 1.1 kV grade, PVC insulated, single core, stranded copper wires. The PVC shall have oxygen index not less than '29' and Temperature index not less than 250C. The wires shall have annealed copper conductors of adequate size comprise not less than three strands

The minimum cross sectional area of the stranded copper conductor used for internal wiring shall be as follows:

- All circuits excepting CT circuits and energy metering circuit of VT-2.5 sq.mm
- All CT circuits and metering circuit of VT-2.5 sq. mm

All internal wiring shall be supported, neatly arranged, readily accessible and connected to equipment terminals and terminal blocks. Wiring gutters and troughs shall be used for this purpose.

Cubicle connections shall be insulated with PVC to IEC 227. Wires shall not be jointed or teed between terminal points.

Bus wires shall be fully insulated and run separately from one another. Auxiliary bus wiring for AC and DC supplies, voltage transformer circuits, annunciation circuits and other common services shall be provided near the top of the panels running throughout the entire length of the panel suite. Longitudinal troughs extending throughout the full length of panel shall be preferred for inter panel wiring.

All inter connecting wires between adjacent panels shall be brought to a separate set of terminal blocks located near the slots of holes meant for the passage of the inter connecting wires. Interconnection of adjacent panels on site shall be straightforward and simple. The bus wires for this purposes shall be bunched properly inside each panel.

Wire termination shall be made with solderless crimping type and tinned copper lugs which firmly grip the conductor. Insulated sleeves shall be provided at all the wire terminations. Engraved core identification plastic ferrules marked to correspond with panel wiring diagram shall be fitted at both ends of each wire. Ferrules shall fit tightly on the wire and shall not fall off when the wire is disconnected from terminal blocks. Numbers 6 and 9 shall not be included for ferrules purposes unless the ferrules have numbers underscored to enable differentiation. (i.e. 6 and 9).

Fuses and links shall be provided to enable all circuits in a cubicle, except a lighting circuit, to be isolated from the bus wires.

The DC trip and AC voltage supplies and wiring to main protective gear shall be segregated from those for back-up protection and also from protective apparatus for special purposes. Each such group shall be fed through separate fuses from the bus wires. There shall not be more than one set of supplies to the apparatus comprising each group. All wires associated with the tripping circuits shall be provided with red ferrules marked "Trip".

It shall be possible to work on small wiring for maintenance or test purposes without making a switchboard dead.

The insulation material shall be suitably coloured in order to distinguish between the relevant phases of the circuit.

When connections rated at 380 volt and above are taken through junction boxes they shall be adequately screened and "DANGER" notices shall be affixed to the outsides of junction boxes or marshalling kiosk.

Where connections to other equipment and supervisory equipment are required the connections shall be grouped together.

LV power cabling:

LVAC cable terminals shall be provided with adequately sized, hot pressed, cast or crimp type lugs. Where sweating sockets are provided they shall be without additional clamping or pinch bolts. Where crimp type lugs are provided they shall be applied with the correct tool and the crimping tool shall be checked regularly for correct calibration. Bi-metallic joints between the terminals and lugs shall be provided where necessary.

Terminals shall be marked with the phase colour in a clear and permanent manner.

A removable gland plate shall be provided by the Contractor. The Contractor shall be responsible for drilling the cable gland plate.

Armoured cables shall be provided with suitable glands for terminating the cable armour and shall be provided with an earthing ring and lug to facilitate connection of the gland to the earth bar.

Multi-core cables and conduit wiring:

External multi-core cabling between items of main and ancillary equipment shall form part of the Contract Works and shall consist of un-armoured multi-core cable with stranded copper conductors PVC insulated and PVC over sheathed complying with the requirements of IEC 227 and 228 as applicable.

Multi-core cable for instrumentation and control purposes shall be supplied with 2.5 mm² stranded copper cores. Multi-core cables for CT and VT circuits shall be supplied with two by 2.5 mm² stranded copper cores and the cores shall be identified by the phase colour.

Where conduit is used the runs shall be laid with suitable falls and the lowest parts of the run shall be external to the equipment. All conduit runs shall be adequately drained and ventilated. Conduits shall not be run at or below ground level.

Multi-core cable tails shall be so bound that each wire may be traced to its cable without difficulty. All multi-core cables shall be provided with 20 % spare cores and the spare cores shall be numbered and terminated at a terminal block in the cubicle. Where cables are terminated in a junction box and the connections to a relay or control cubicle are continued in conduit, the spare cores shall be taken through the conduit and terminated in the cubicle. The dc trip and ac voltage circuits shall be segregated from each other as shall the circuits to main protective gear be segregated from those for back-up protection.

The screens of screened pairs of multi-core cables shall be earthed at one end of the cable only. The position of the earthing connections shall be shown clearly on the diagram.

All wires on panels and all multi-core cable cores shall be crimped with the correct size of crimp and crimping tool and will have ferrules which bear the same number at both ends. At those points of interconnection between the wiring carried out by separate contractors where a change of number cannot be avoided double ferrules shall be provided on each wire. The change of numbering shall be shown on the appropriate diagram of the equipment. The same ferrule number shall not be used on wires in different circuits on the same panels.

The Contractor shall provide a two (2) metre loop of spare cable at both ends of all multi-core cable runs and shall leave sufficient lengths of tails at each end of the multi-core cables to connect up to the terminal boards. The Contractor shall also strip, insulate, ring through and tag the tails and shall also seal the cable boxes. The Contractor shall be responsible for re-checking the individual cores and for the final connecting up and fitting of numbered ferrules within all equipment provided on this contract.

The drilling of gland plates, supply and fitting of compression glands and connecting up of power cables included in the Contract scope of work shall be carried out under this contract.

Laying and installing of cables:

General:

For cable laying the following shall apply:

- Switchyard area - In concrete cable troughs (cable trench having cable racks with cable trays)
- Control Room On cable racks consisting of slotted type and ladder type cable trays
- Buildings Conduits

Directly buried cables shall be used wherever necessary with the approval of Engg. Incharge (Divisional Engr.).

Laying of cable:

Cables shall be laid in concrete troughs provided under this contract or drawn into pipes or ducts or on cable racks or directly buried as may be required by the Engg. Incharge (Divisional Engr.). Concrete troughs shall be designed so that the cables are supported on cable support systems and the supports shall be arranged so as to allow the segregation of power, control (including CT and VT circuits) and communications cables onto different layers of cable supports. All cable supports shall be earthed in accordance with IS 3043. The minimum vertical separation between layers of cable tray shall be not less than 300 mm.

The cable support system shall be designed and constructed to carry the required cables without undue crowding of the supports and without overloading the supports. The maximum number of layers of cable that shall be permitted on a single cable support shall be three. The width of the cable supports shall be selected to ensure that the supports are not crowded, the cable supports are not overloaded and that sufficient space is provided in the cable trough to allow for personnel access during and after cable installation. The width of cable supports should not exceed 750 mm.

Cables shall be laid direct in the ground only at the discretion of the Engg. Incharge (Divisional Engr.). All cables laid direct in the ground outside buildings shall be laid in a trench and protected by reinforced concrete slabs or cable tiles.

For auxiliary cables the top of the slab or tile shall be at a depth not less than 300 mm below the

surface of the ground and there shall be a layer of fine well packed riddled earth 75 mm thick in between the cable and the bottom of the trench and between the top of the cable and the underside of the slab.

The Contractor shall be responsible for the proper laying of all cables in the ground. Where cables in the same trench are laid over each other, they shall be separated by not less than 75 mm of riddled earth. The riddled earth used for this purpose shall have been passed through a screen having a 12 mm square mesh.

Where cables pass under roadways they shall be laid in pipes at a depth not less than 800 mm below the surface.

The Contractor shall be responsible for the excavation of trenches which shall include all pumping and baling required and the provision of all necessary labour, plant, tools, water, additional soil, fuel or motor power for such purposes.

Cables in trenches will be inspected by the Engg. Incharge (Divisional Engr.) Before the trenches are backfilled.

The running of communications and power cables along the same route shall be avoided as far as possible. Where this is not possible they shall be segregated, the one group from the other. Power and communication cables shall be laid in separate tiers. For other than directly buried cables the order of laying of various cables shall be as follows:

- Power cables on top tiers.
- Control/ instrumentation and other service cables in bottom tiers.

Cable tags and markers:

Each cable and conduit run shall be tagged with numbers that appear in the cable and conduit schedule.

The tag shall be of aluminium with the number punched on it and securely attached to the cable conduit by not less than two turns of 20 SWG GI wire conforming to IS 280. Cable tags shall be of rectangular shape for power cables and of circular shape for control cables.

Location of cables laid directly in the ground shall be clearly indicated with cable marker made of galvanised iron plate.

Location of buried cable joints shall be indicated with a cable marker having an additional inscription "Cable joint".

Cable markers shall project 150 mm above ground and shall be spaced at an interval of 30 meters and at every change in direction. They shall be located on both sides of road and drain crossings.

Cable tags shall be provided on all cables at each end (just before entering the equipment enclosure), on both sides of a wall or floor crossing, on each duct, conduit entry and at every twenty meters (20 m) in cable tray/trench runs. Cable tags shall be provided inside switchgear, motor control centres, control and relay panels etc.. and wherever required for cable identification when a number of cables enter together through a gland plate.

The price of cable tags and markers shall be included in the installation rates for cables/conduits quoted by the Bidder.

Cable supports and cable tray mounting arrangements in control room:

The control room will normally be provided with embedded steel inserts on concrete floors/walls for the purpose of cabling in the control room. The supports shall be secured by welding to these inserts or available building steel structures. However, in cases where no such embedded steel inserts are available, the same shall have to be secured to the supports on walls or floors by suitable anchoring.

Cable support structure in switchyard cable trenches:

The contractor shall fabricate and install cable support structures in cable trenches. These supports shall be provided at 750 mm spacing along the run of cable trenches.

Cable supports and cable racks shall be fabricated from standard structural steel members, channels, angles and flats of required size. The fabrication, welding and erection of these structures shall conform to the relevant clauses of this Specification, in addition to the specification given herein.

Termination of cables and wires:

Where cables leave the apparatus in an upward direction the cable boxes shall be provided with a barrier joint to prevent leakage of cable oil or compound into the apparatus. Where cable cores are liable to contact with oil or oil vapour the insulation shall be unaffected by oil.

PVC sheathed cables shall be terminated by compression glands complying with BS 6121 (or equivalent).

Auxiliary PVC insulated cables shall be terminated with compression type glands, clamps or armour clamps complete with all the necessary fittings.

Colours shall be marked on the cable box, cable tail ends and single core cables at all connecting points and/or any positions the Engg. Incharge (Divisional Engr.) May determine. Cable boxes shall be provided with suitable labels indicating the purpose of the supply where such supply is not obvious or where the Engg. Incharge (Divisional Engr.) May determine.

All cables shall be identified and shall have phase colours marked at their termination.

All incoming and outgoing connections shall be terminated at a terminal block. Direct termination into auxiliary switches will not be accepted.

DEGREES OF PROTECTION:

Degrees of protection shall be provided in accordance with IEC 144 and IEC 529 and be as follows:

- For outdoor applications, IP 55.
- For indoor applications where purpose built accommodation is provided, e.g. switch and control and relay rooms in auxiliary plant buildings, IP 41.
- Where dust can adversely affect equipment within the enclosure, this equipment should be separately housed with a degree of protection of IP 51.
- For indoor applications where the equipment is housed in the same building as that enclosing water and steam operated equipment, the degrees of protection stated in the previous paragraph shall be up-rated to IP 44 and IP 54 respectively.

Where more severe environments exist, e.g. steam and oil vapour or other deleterious chemical environments, special measures will be necessary and the degree of protection required will be specified separately.

The Contractor shall submit a schedule for providing the degree protection to various control boxes, junction boxes etc. for the Engg. Incharge (Divisional Engr.)s approval.

SUPPLY VOLTAGE:

All incoming supplies of greater than 125 V to earth shall have their termination shrouded by a suitable insulating material.

The auxiliary supply voltages on site shall be as follows:

Nominal Voltage V	Variation	Frequency Hz or DC	Phase	Wires	Neutral Connection
430	±10%	50±5%	3	4	Solidly earthed
240	±10%	50±5%	1	2	Solidly earthed
220	187V-242V	DC	DC	2	Isolated 2 wires
50	45V - 55V	DC	DC	2	+ve earthed

CONSTRUCTION MANAGEMENT:

General:

Time is the essence of the Contract and the Contractor shall be responsible for performance of his Works in accordance with the specified construction schedule. If at any time the Contractor is falling behind the schedule, he shall take necessary action to make good for such delays by increasing his work force or by working overtime to accelerate the progress of the work and to comply with schedule and shall communicate such actions in writing to the Engg. Incharge (Divisional Engr.), providing evidence that his action will compensate for the delay. The Contractor shall not be allowed any extra compensation for such action.

Field office records:

The Contractor shall maintain at his Site office up-to-date copies of all drawings, specifications and other supplementary data complete with all the latest revisions thereto. The Contractor shall also maintain in addition the continuous record of all changes to the above contract documents, drawings, specifications, supplementary data, etc. effected at the field. On completion of his total assignment under the Contract, such drawings and engineering data shall be submitted to the Engg. Incharge (Divisional Engr.) in the required number of copies.

Protection of property and Contractor's liability:

The Contractor will ensure provision of necessary safety equipment such as barriers, sign-boards, warning light and alarms, personal protective equipment etc. to provide adequate protection to persons and property. The Contractor shall be responsible for giving reasonable notice to the Engg. Incharge (Divisional Engr.) and the owners of public or private property and utilities when such property and utilities are likely to be damaged or injured during the performance of his works, and shall make all necessary arrangements with such owners, related to removal and/or replacement or protection of such property and utilities.

CODE REQUIREMENTS:

The erection requirements and procedures to be followed during the installation of the equipment shall be in accordance with the relevant Indian/International Standards/Regulations, ASME codes, accepted good engineering practice, drawings and other applicable Indian codes and laws and regulations.

EMPLOYER'S SUPERVISION:

To eliminate delays and avoid disputes and litigation, it is agreed between the Parties to the Contracts that all matters and questions shall be referred to the Employer and without prejudice the Contractor shall proceed to comply with the Employer's decision.

The work shall be performed under the direction and supervision of the Engg. Incharge (Divisional

Engr.). The scope of the duties of the Engg. Incharge (Divisional Engr.), pursuant to the contract, will include but not be limited to the following:

- Interpretation of all the terms and conditions of these documents and specifications.
- Review and interpretation of all the Contractors drawing, engineering data etc.
- Witness or authorize his representative to witness tests and trials either at the manufacturer's works or at site, or at any place where work is performed under the Contract.
- Inspect, accept or reject any equipment, material and work under Contract.
- Issue certificate of acceptance and/or progressive payment and final payment certificates.
- Review and suggest modification and improvements in completion schedules from time to time.
- Supervise the Quality Assurance program implementation at all stages of the Works.

TESTING AND INSPECTION:

The Contractor shall carry out the tests stated in accordance with the conditions of this Specification, without extra charge for such additional tests as in the opinion of the Engg. Incharge (Divisional Engr.) are necessary to determine that the Contract Works comply with this Specification. The tests shall be carried out generally in accordance with the relevant IEC's or IS or equivalent standards. The specific details of testing and inspection are given in the appropriate section of this Specification.

The Contractor shall submit Type Test Reports for all equipment being supplied by him for the Engg. Incharge (Divisional Engr.)'s approval. The Engg. Incharge (Divisional Engr.) may also give instruction to carry out Type Tests, routine tests or acceptance tests. Type Test Charges shall be paid as per the rates indicated in the Price Schedules.

All materials used shall be subjected to such routine tests as are customary in the manufacture of the types of plant included in the Contract Works. These materials shall withstand satisfactorily all such tests.

All tests shall be carried out to the satisfaction of the Engg. Incharge (Divisional Engr.), in his presence, at such reasonable times as he may require, unless agreed otherwise. Not less than three weeks' notice of all tests shall be given to the Engg. Incharge (Divisional Engr.) in order that he may be represented if he so desires. As many tests as possible shall be arranged together. Six copies of the Contractor's test reports and test sheets shall be supplied to the Engg. Incharge (Divisional Engr.) for approval.

Measuring apparatus shall be approved by the Engg. Incharge (Divisional Engr.) and if required shall be calibrated at the expense of the Contractor at an approved laboratory.

The Contractor shall be responsible for the proper testing of the work completed or plant or materials supplied by a sub-contractor to the same extent as if the work, plant or materials were completed or supplied by the Contractor himself.

All apparatus, instruments and connections required for the above tests shall be provided by the Contractor, but the Engg. Incharge (Divisional Engr.) may permit the use for the tests on site, any instruments and apparatus which may be provided permanently on site as part of the contract works conditional upon the Contractor accepting liability for any damage which may be sustained by such equipment during the test.

The contractor shall supply suitable test pieces of all materials as required by the Engg. Incharge (Divisional Engr.). If required by the Engg. Incharge (Divisional Engr.), test specimens shall be prepared for check testing and forwarded at the expense of the Contractor to an independent testing authority selected by the Engg. Incharge (Divisional Engr.).

Any costs incurred by the Employer in connection with inspection and re-testing as a result of a

failure of the subject under test, or damage during transport, or erection on site before take-over by the Employer, shall be to the account of the Contractor.

No inspection or lack of inspection or passing by the Engg. Incharge (Divisional Engr.) of work, plant or materials, whether carried out or supplied by the Contractor or sub-contractor, shall relieve the Contractor from his liability to complete the Contract Works in accordance with the Contract or exonerate him from any of his guarantees.

FIRE PRECAUTIONS:

All apparatus, connections and cabling shall be designed and arranged to minimise the risk of fire and any damage which might be caused in the event of fire. When cabling is carried out as part of this Contract the Contractor shall be responsible for sealing all holes in floors, walls, roofs etc. through which the cabling may pass.

The work procedures that are to be used during the erection shall be those which minimise fire hazards to the maximum extent practicable. Combustible materials, combustible waste and rubbish shall be collected and removed from the site at least once each day. Fuels, oils and volatile or flammable materials shall be stored away from the construction site and equipment and material stores in appropriate safe containers.

All Contractor's supervisory personnel and at least ten percent all of workers shall be trained for fire-fighting and shall be assigned specific fire protection duties. At least ten percent of all personnel assigned to site at any one time shall be trained for firefighting.

The contractor shall provide sufficient fire protection equipment of the types and sizes for the ware-houses, office temporary structures, labour colony area etc.. Access to such fire protection equipment shall be easy and kept open at all time.

PACKING, SHIPPING AND TRANSPORT:

The Contractor shall be responsible for the packing, loading and transport of the plant and equipment from the place of manufacture, whether this is at his own works or those of any Contractor, to Site, and for off-loading at site.

All apparatus and equipment shall be carefully packed for transport by air, sea, rail and road as necessary and in such a manner that it is protected against tropical climate conditions and transport in rough terrain and cross country road conditions. The method of packing shall provide complete protection to all apparatus and equipment during transport and storage at site in heavy rain. The method of packing shall provide adequate protection to main items of plant and those parts contained within and attached without, for transportation.

Precautions shall be taken to protect parts containing electrical insulation against the ingress of moisture.

All bright parts liable to rust shall receive a coat of anti-rusting composition and shall be suitably protected. The machined face of all flanges shall be protected by means of a blank disc bolted to each face.

Where appropriate all parts shall be boxed in substantial crates or containers to facilitate handling in a safe and secure manner. Each crate or container shall be marked clearly on the outside of the case to show "TOP" and "BOTTOM" positions with appropriate signs, and where the mass is bearing and the correct position for slings. Each crate or container shall also be marked with the notation of the part or parts contained therein, contract number and port of destination. It shall be the Contractor's responsibility to dispose of all such packing.

Any damage due to defective or insufficient packing shall be made good by the Contractor at his own expense and within reasonable time when called upon by the

Engg. Incharge (Divisional Engr.) to do so. Four (4) copies of complete packing lists showing the number, size, marks, mass and contents of each package shall be delivered to the Engg. Incharge (Divisional Engr.) immediately the material is despatched.

The Contractor shall inform himself fully as to all relevant transport facilities and requirements and loading gauges and ensure that the equipment as packed for transport shall conform to these limitations. The Contractor shall also be responsible for verifying the access facilities specified.

The Contractor shall be responsible for all costs of repair or replacement of the equipment, including those incurred by the Employer, arising from damage during transport, off-loading or erection on site, until take-over by the Employer.

The Contractor shall be responsible for the transportation of all loads associated with the contract works and shall take all reasonable steps to prevent any highways or bridges from being damaged by his traffic and shall select routes, choose and use vehicles and restrict and distribute loads so that the risk of damage shall be avoided. The Contractor shall immediately report to the Engg. Incharge (Divisional Engr.) any claims made against the Contractor arising out of alleged damage to a highway or bridge.

ERECTION MARKS:

Before leaving the Contractor's Works all apparatus and fittings shall be painted or stamped in two places with a distinguishing number and/or letter corresponding to the distinguishing number and/or letter on an approved drawing and material list. All markings shall be legible; weatherproof tags, where used, shall be durable, securely attached and duplicated

The erection marks on galvanised material shall be stamped before galvanising and shall be clearly legible after galvanising.

SPANNERS AND SPECIAL TOOLS:

A complete set of spanners shall be supplied for each station to fit every nut and bolt head on the apparatus supplied under this Contract, together with all special tools required for the adjustment and maintenance of the equipment. These tools shall be mounted in a lockable cabinet at each substation, also to be provided under this Contract. Eye bolts which have to be removed after use shall be accommodated in the cabinets.

Spanners and other maintenance equipment provided under the Contract shall not be used for the purpose of erection of the contract Works.

Any special devices, slings or tackle necessary for the complete overhaul of the plant shall be handed over to the Engg. Incharge (Divisional Engr.) in working order on completion of the Contract.

On delivering any or all of these tools to the Engg. Incharge (Divisional Engr.), a signature shall be obtained from the Engg. Incharge (Divisional Engr.)'s representative. Any tools not signed for shall be deemed not to have been delivered.

23. RUNWAY BEAMS, EYE BOLTS AND LIFTING TACKLE

Runway beams shall comply with the requirements of BS 2853, or its equivalent, and shall be tested after erection in accordance with this standard and this Specification. The Contractor shall be responsible for the provision of the appropriate test certificates which must be in accordance with Appendix C of BS 2853.

All slings, eye bolts and other lifting tackle provided shall be proof tested to twice the safe working load and suitably marked with embossed labels to show clearly the safe working loads.

ENVIRONMENTAL CONDITIONS:

TFL is situated in Angul District of Odisha. It is approximately 125km at a nearest distance from

Bhubaneswar, Odisha. The Altitude is less than 1000 metres from Sea Level.

CLIMATIC CONDITIONS:

1.	Maximum Ambient Air Temperature	50 °C
2.	Maximum Daily Average Ambient Temperature	32 °C
3.	Minimum Ambient Air Temperature	5 °C
4.	Maximum Relative Humidity	85%
5.	Average Annual Rainfall	150cm
6.	Average Nos. of Rainy Days per Annum	70 days
7.	Average No. of Thunder Storms Days per Annum	77 days
8.	Intensity of Pollution	Very Heavy
9.	Is the Site susceptible to Earth Quakes of severe intensity?	Yes, Zone III
10.	Altitude below Mean Sea Level	1000 metres
11.	Seismic Co-efficient	0.06g Hori 0.01g Vert
12.	Creepage Distance	31 mm / kV

ELECTRICAL CHARACTERISTICS:

GENERAL:

OPTCL substation 220kV and 33kV system covered by this document are grounded. The 220kV and 33kV system design shall be in accordance with the requirements outlined in OPTCL Standard.

- The Short Circuit rating of the 220kV system shall be 50kA, 3s.
- The Short Circuit rating of the 33kV system shall be 31.5kA, 3s.

SUBSTATION ELECTRICAL SYSTEM:

220kV GIS:

- 220kV GIS all taps if CT & PT secondary windings shall be brought to an easily accessible location such as local control cubicle.
- Metering Cores/Windings of CT and PT Secondary shall have an accuracy class of 0.2S.

33kV Outdoor Switchyard:

The 33kV outdoor switchyard shall be provided with necessary CT's as per 33kV Outdoor Equipment Technical specification. The CT & PT shall meet the requirements furnished by the OWNER.

The cable terminal lug for feeders shall be one (1) hole type as per OPTCL Standard.

LV Cable Terminations:

Power cables shall be terminated in accordance with cable manufacturer's recommendations. Control wiring cable tails shall be bound in such a way that each wire may be traced back to its associated cable. Core of multi-core or multi-pair cables shall be grouped together. All spare cores shall be numbered and terminated in spare terminals farthest from the cable gland. Each core of the control and instrumentation cable shall be identified with numbered ferrules. The ferrules shall be made of insulating materials.

Cable glands shall be used at all equipment to support the weight of the cables. Compression (indentation) type cable lugs shall be used for all terminations. All conductor joints shall be made at terminal points. All wires associated with trip circuit shall be clearly marked "TRIP" and provided with red sleeves.

All terminals shall be designed to receive (on either side) two (2) nos. of cable cores of used cross-section. Each terminal block shall be marked for circuit identification. The terminal blocks for AC and DC circuits shall be grouped separately. Terminal blocks mounting arrangement shall provide easy access to wires, terminations and ferrules.

AC Sub Distribution Panels:

4-pole ACBs shall be provided on incomer and bus couplers and shall be as per LT SWITCHGEAR Technical Specification.

220V & 48V DC Auxiliary Power Supply:

The DC auxiliary power supply shall consist of two (2) 100% DC battery bank and two (2) battery chargers each rated 100% capacity.

The CONTRACTOR shall be furnished with battery sizing calculations by the OWNER.

The 220V batteries shall be Lead Acid Plante Type & 48V batteries shall be VRLA type.

DESIGN PHILOSOPHY FOR PROTECTION, CONTROL AND METERING

SYSTEM

Protection Philosophy.

The control and protection system shall be closely inter related in the sub-station.

The protection system shall be designed for the fault clearing time, so that it prevents or limits damage to primary equipment of the transmission system, and stability of the power system shall be protected. The main protective system shall be capable of tripping (excluding circuit breaker operating time) within 10 - 50ms. However, in any case the fault clearing time from the instant of inception of fault to completion of the circuit breaker operation shall not exceed 100ms for 220kV

systems, and 150ms for 33kV system. Operating time of breakers to be provided by the Employer are 50ms for 220kV, and 60 to 85ms for 33kV.

The protection system shall generally be a dedicated system organised at bay level for lines, transformers etc., and at sub-station level for bus bar and breaker failure protection .

In the highest range of protection functions the protection unit and function shall be segregated as much as possible. The protection shall not be compromised in any way by the requirements of the other functions. The protection shall be permanently on line and shall be capable of tolerating faults in both the hardware and software at bay level and sub-station level. The system shall be so designed that in the event of loss of communication between the bay level and sub-station level, the continuity of protection function shall be ensured.

The protection sub-system (relays) should communicate with control and monitoring system to provide information regarding operation, faulted phase, settings etc.. Information should also be available at station computer level and for transmission to LDC via SCADA.

The protection system may also include new designs of protective relays incorporated with features such as auto reclosing, fault recording, fault locating and synchronising check.

The recommended protection arrangement for different bays shall be in accordance with the protection single line diagrams attached to this Specification.

Bus bar protection systems shall be designed to initiate immediate tripping of all circuit breakers connected to the faulted section of the bus bar. In the event of non-operation of a circuit breaker of a bay all the circuit breakers connected to the associated bus bar shall trip under breaker failure protection.

Control Philosophy:

The control function of the sub-station shall be the following:

- Control — Operation (switching on or off or position change)
- Control — Monitoring (alarms, annunciation, indication etc.)

The system shall efficiently perform the operation of circuit breakers, isolators, tap changers etc.. It shall also perform the interlocking at bay level as well as substation level. The control system shall be suitable for operating manually, electrically (remote) and via SCADA system from a remote control center.

Control shall be achieved at bay level, substation level and remote control centre level through conventional MMI or computer based automated system, as specified in this Specification.

The system shall be designed, along with the communication system so that there shall be high availability of bay protection associated with automatic functions such as auto reclosing. The systems shall function autonomously and independently of adjacent bays, substation functions and units etc.

DESIGN OF SUBSTATION:

GENERAL:

The substation shall adopt switching scheme as shown on the attached single line diagrams. The Contractor shall propose the most economical substation layout that meets the desired degree of operational flexibility, reliability, service continuity and expandability. The contractor shall submit design considerations establishing the above and proposals for the Engg Incharge (Divisional Engr.) approval. The attached drawings are intended to show the basic requirements to be satisfied, i.e. switching arrangement, number of busbars, site location, available area, line termination etc. It is the responsibility of the Contractor to prepare a detailed layout showing the manner in which the various items of equipment offered can be accommodated to best advantage within the available area.

The arrangement shown on the attached drawings may be modified as necessary to accommodate the various items, e.g. different types of disconnecter, provided the basic principles are maintained.

The Bidder is at liberty to offer substation arrangements based on significantly different principles where it is considered that these offer economies or technical advantages. It is emphasised, however, that the Bidder's main offer should comply with the principles shown in the attached drawings, other arrangements being submitted solely as alternatives to the main offer.

DESIGN PARAMETERS - OPEN TERMINAL:

The substation design should be such as to minimise the number of levels of conductors and to ensure that the consequences of a failure of one set of high level conductors are limited to the loss of that circuit and a single busbar section. This principle shall also be applied with regard to earth wire conductors. All materials and equipment for use in the substation shall be suitably rated to meet the site conditions specified in the schedules.

All gantry type structures supporting conductors shall include facilities for ready access to all insulator sets. There shall be permanently attached climbing devices with guard-rails and access to high level beams shall not be possible without proper authorisation. Safety screens shall be provided between adjacent circuits to maintain the specified safety clearances and to prevent accidental access to live circuits.

Vehicle access to permit the transport of major switchgear equipment shall be provided. This shall be achieved without the need to de-energise circuits. Access for vehicles which require the de-energisation of circuits shall be kept to a minimum and avoided wherever possible.

Each substation shall be adequately protected against direct lightning strikes, either by the use of spikes or earth wires located on the substation structures, the use of spikes is preferred. The height, location, and number of spikes or earth wires shall be such as to protect all equipment installed within the substation to a failure rate of shielding from direct lightning strikes of not greater than 0.1 per cent per annum.

Where the connection to the substation is by overhead line, overhead line conductors will be terminated either at the substation gantry structures or to anchor blocks adjacent to the overhead line terminal towers. The overhead line conductors complete with tension insulators, line tee off clamps, and compression fittings (bimetallic where necessary) shall be supplied and erected under a separate contract. The Contractor shall provide facilities on the gantry structure for the fixing of the tension insulators and arrange branching of conductors in to the sub-station from the transmission line conductors.

The overhead line earth wire will be extended into the substation and the substation gantry structure shall be arranged to receive this.

Where line traps are to be located within the substation, these should preferably be mounted integrally with the coupling capacitor. Should this be impracticable, then the use of post type insulators is preferred to suspension mounting.

Where disconnectors are of the pantograph type, the contact arrangements shall cater for conditions of maximum wind loading coincident with either the maximum or minimum ambient temperature and shall conform to the requirements of IEC 129. The Contractor shall also establish, through calculations, the length of arm of each pantograph isolator so that the contact is proper and robust. The Contractor shall also provide the required size and number of sag compensating springs where necessary.

Sub-station equipment, structures, roads, concrete cable troughs, drains etc.. Shall be laid out in a neat and organised manner to meet the employers requirement, facilitate movement of vehicles and ensure safety of personnel and equipment.

Each substation shall be provided with safety grounding mat as per clause relevant clauses of this section. While designing the ampacity of the buried conductor suitable corrosion allowance shall be

considered for thirty five (35) years. The conductors shall be buried at a depth of 700 mm from finished formation level. The conductors shall be welded suitably for maintaining a high degree of mechanical rigidity and electrical connectivity.

The substation earth mat shall be designed to provide a ground potential rise within safe limits of tolerable touch and step potential. The margins of limits shall confirm the international practices. The design of earthmat shall be in accordance with IEEE-80/1986 and shall be submitted for Engg Incharge (Divisional Engr.) approval.

BUSBAR CONSTRUCTION:

Bus bars of ACSR conductor as per the provision of Tender Document. The bus bar capacity shall be designed for maximum ambient temperature conditions and symmetrical short circuit condition. The continuous current rating shall be so designed that no portion of the bus bar is unduly loaded, or over heated. For EHV sub-stations, the bus bar and bus bar fittings shall be made corona free by the provision of corona rings or corona bells. There shall not be any harmful RIV from the constructed bus bars.

Strain bus bars shall be made bundled wherever necessary to carry the rated maximum continuous current. The bundle size shall be determined by the Contractor to make such that it is corona free, and fitted with spacers to limit the snatch forces such that no dangerous tensions are passed on to the structures.

Interconnections to equipment shall be made from suitable flexible ACSR conductors, through clamps and connectors only. Jumpers shall be made from flexible ACSR conductors only.

The Contractor shall submit design calculations in support of the various dimensions of the bus bar for Engg Incharge (Divisional Engr.) approval. The stranded conductor sag shall not exceed 1/80th of conductor span.

PROVISION OF EARTH SWITCHES:

The earth switches shall be provided liberally in compliance to Indian Electricity Rules and as per latest recommendations of CBIP Manual on EHV substations.

However the Employer's practice is to provide earth switches with disconnecter on bus bar side and feeder side of the circuit bay for all voltage class substations.

Each substation shall be provided with sufficient number of portable earth switches so as to carry out maintenance works for at least two circuit bays.

REVENUE ENERGY METER:

The Energy Meter shall be draw out type and shall meet the requirements of OPTCL Standard. The Class of Energy Meter shall be 0.2 as per ANSI. The Energy Meter shall provide the following measurement:

- a. kWh
- b. kVarh
- c. kW & Max recorded kW
- d. kVar & Max recorded kVar
- e. kVA & Max recorded kVA

Totalizer shall be provided along with the revenue meter to provide Gross MWh & MVARh

The Energy Meter should be compatible with the printer being provided to print the required data.

The Revenue Meter shall be housed in a separate Metering Panel with its associated test switch.

Computer and Printer Requirements:

One (1) Lap Top Computer along with all relevant software, calibration, maintenance & commissioning of Energy Meter, Power Factor & Maximum Demand Recording System shall be provided at the time of commissioning and subsequent handing over to OPTCL.

One Color printer shall be provided for Energy Meter, Power Factor & Maximum Recording System.

ALARM AND ANNUNCIATOR SYSTEM:

The alarm and annunciator system shall meet the functional requirements of applicable OPTCL standard.

The alarm and annunciator functional requirements shall be integral part and features of proposed SAS.

The alarms indicated in Technical Specification, as applicable for the PROJECT shall be provided as a minimum. The exact number of alarms required shall be finalized during the base/detailed engineering stage of the PROJECT when all schematics are available for review.

INTERLOCKING SYSTEM:

General:

The applicable recommended interlocking facilities of IEC 517 shall be provided. Padlocking to the requirements of this specification shall be provided for operational and maintenance security.

Earth switches on line circuits shall be capable of interrupting the current induced in the line at the voltage specified in the schedules. This current may arise by induction from a fully loaded line in parallel with the earthed line. If earth switches without the rated breaking capacity are provided, the interlocking arrangements shall ensure the interruption of this induced current by the circuit breaker before the earth switch is opened. Interlocking facilities shall be provided to release the circuit breaker for maintenance whilst maintaining the earthing of the incoming line.

Philosophy:

All disconnecting and earthing devices within the substation shall be interlocked in a manner that ensures that they always operate safely. The system employed shall satisfy two distinct categories:

- **Operational interlocking:** Interlocking associated with normal system operation and switching and intended to ensure that a predetermined switching sequence is satisfied. Such interlocking shall be achieved by electrical means in a manner that permits the equipment to perform any safe operation.
- **Maintenance Interlocking:** Interlocking associated with a series of switching operations to render the equipment or sections of the substation safe for access and maintenance by personnel. Such interlocking shall be achieved by mechanical interference type interlocks.

Principles:

The design of the interlocking scheme shall be based upon the following principles:

- a) Disconnectors are capable of switching the capacitive currents of associated connections.
- b) Circuit breakers shall not be used as a point of safety isolation, this is the function of a disconnector.
- c) Dis connectors have neither load making nor breaking capacity.
- d) Dis connectors are not capable of making or breaking transformer magnetising current.
- e) Dis connectors are capable of the duty imposed when operated under parallel switching

conditions.

- f) It shall not be possible to close or open any earth switch unless the point of application is disconnected from all possible sources of supply, and the power operating devices of such dis connectors are selected to the local control position.
- g) It shall not be possible to operate any disconnecter unless its associated circuit breaker is open.
- h) It shall not be possible to operate any disconnecter if an associated earth switch is already closed.
- i) Dis connectors concerned with supplies from a remote point cannot be fully interlocked and shall carry a warning notice to this effect. Similar notices shall be applied to earth switches.

EARTHING SYSTEM:

Electrical measurements of the subsoil at various depths up to 20 metres shall be made at the site of each substation in order to determine the layered effects of the ground from which the effective ground resistivity and hence the expected resistance of the proposed earth grid system may be predicted. Wanner's 4 - Electrode method as per IEEE-Std 81 may be followed for measurement of earth resistivity.

The earthing system shall comprise a mesh grid formed by hot dip galvanised iron flat bar (GI flat) of 75 X 10 mm buried directly in the ground and arranged so as to utilise fully the available site area and the risers shall be 50 x 6 mm GI flat as per OPTCL specifications. A continuous conductor shall be laid outside the periphery of the substation site at a distance of two metres from the switchyard fence and at a depth of at least 0.7 metres (the earth mat top shall be at 700 mm below the finished ground level) below the surface. A mesh system shall be formed by interconnection at various points to the perimeter conductor. The distance between two buried earth mat (flat/rod) shall be maximum 5 meters both way. The mesh system shall be designed such that the grid potential rise limits the touch voltage to a value not greater than the maximum tolerable touch potential; the fault clearance time to be used in the earthing calculations shall be taken as one second.

The earthing system shall be designed using CDEGS or equivalent software to meet the requirements of this specification and shall be in accordance with IEEE 80 and IS 3043. The Contractor shall present calculations to show the earthing system meets these requirements and can be shown to be safe in terms of touch, step and transferred potentials. The calculations shall be carried out considering a layer of crushed metals of thickness 100mm and without the same; and if applicable recommend suitable site surfacing . The resistance of the earth mat shall not exceed 0.5%.

In the event of the substation resistance obtained with the foregoing installation being of a magnitude unacceptable to the Engg Incharge (Divisional Engr.), then where practicable, the ground area enclosed by the earth system should be increased by installing directly in the ground a GI flat /MS rod conductor in the form of a ring around the site at a significant distance from the boundary fence. Alternatively, earth conductors can be directly buried radially outside the substation perimeter fence. The use of earth plates as current carrying electrodes is not acceptable.

The earthing system shall be designed so as to include all overhead line terminal towers, which shall be earthed by extending the system so as to envelope all towers within the earth system. Each tower shall be bonded directly to the earth system from at least two locations. Structures and masts for lighting and security surveillance equipment shall also be within the perimeter of the earth grid. No fixed low voltage equipment, with the exception of a warning or alarm button and intruder alarms which shall be of the double insulation type, shall be erected outside the perimeter of the earth grid.

Where a metal substation fence is provided, this shall be bonded electrically to the earthing grid on each side at spacing not exceeding $0.25r$ (where r is the equivalent circular plate radius), at points adjacent to each corner and immediately below any overhead line entering or leaving the Site. The location of the mesh conductors shall be such as to enable all items of equipment to be connected to the earth system via the shortest possible route.

Gate posts forming part of the substation fence shall be bonded together with below ground connections and the gates themselves shall be electrically bonded to the posts at two points through flexible braids.

The current density of the earth conductor shall be not greater than 100A/mm². Single connections between equipment and the earth system shall carry the total short circuit current, but the cross sectional area of branch connections may be reduced to take account of current distribution in two or more conductors. A distribution of 60 per cent shall be assumed for this purpose, i.e. the cross sectional area of branch connections may be reduced to 60 per cent of the corresponding single conductor.

The earth conductor may be sized as per IEEE 80 and sufficient allowance for corrosion may be taken in to account.

The grid voltage rise under fault conditions shall not exceed 15 kV. If the calculated grid voltage rise exceeds 430V, the local Telephone Authority shall be advised, by the Contractor, of the grid voltage rise and the distance of the 650V contour from the substation grid periphery.

The alternative approach of independently earthing the fence and placing it outside the earth grid area shall only be adopted if the above mentioned procedures prove insufficient or impracticable. The Contractor shall provide calculations to show that this approach produces safe touch voltages at the fence and shall ensure that the fence is isolated from all other buried metalwork.

Metal parts of all equipment, other than those forming part of an electrical circuit, shall be connected directly to the main earth system at two points. For the same the size of the G.I flats shall also be 50X6mm. This is the raiser of the earth to the structures of column, beam and all equipment structures. The arrangement of the mesh earth system shall be such as to minimize the length of these connections.

A separate set of earth electrodes (at least two), GI pipe, perforated, 50mm dia, heavy duty having 3000mm long in a treated earth pit bore of 300 mm and filled with Bentonite and Soil Mixture as per guidelines, shall be provided for the earthing for high frequency coupling equipment (CVT etc.), surge arresters, IVT, each neutral of the transformers and reactors at a position immediately adjacent to the equipment being earthed in addition to the normal earth connection.

All main members of structural steelworks shall be earthed by GI flat (size 75X10mm) earthing connections being bonded to the steelworks. The Contractor shall be responsible for earthing of the transformers and circuit breakers installed on the substation site as per recommended.

Connections to apparatus and structures shall be made clear of ground level, preferably to a vertical face and protected against corrosion.

Earth bars installed directly into the ground should normally be laid bare and the trench back-filled with a fine top soil. Where the soil is of a hostile nature, precautions must be taken to protect the earth bar.

All exposed joints shall be at a minimum height of 150 mm above floor or ground level.

A facility shall be provided on the earth bar run between the equipment and the base of the structure, comprising a looped copper strip (test link), so as to permit the attachment of portable earth connections for maintenance purposes.

After installation of the earth system the Contractor shall measure the resistance of the substation. The method used shall preferably be the "fall of potential" method, requiring the availability of a local low voltage supply, but other methods using an earth resistance meter will be acceptable in the event of a local supply being unavailable.

The fencing of the switch yard also to be earthed by using G.I flats of size 75X10mm to each post and a continuous earth strip of size 50X6mm shall run all through the fence. The periphery of the switch yard shall be provided with non-treated earth pit at a distance of 5 mtrs all along the periphery.

The size of the non-treated pit conductor shall be 40 mm dia MS rod of length 3000mm. The said earth MS Rod to be placed in earth pit as per standard practice and the pit shall be filled with Bentonite powder mixed with lomy soil at a ratio 1:10. There shall be provision of watering into the earth pits. A pipe of adequate size should run all along the periphery and outlets shall be provided to each pit. The pipe shall be connected to the overhead tank provided on the control room building and proper water control valve should be provided. Contractor shall prepare a detail earthing provision considering as per specification and shall obtain approval from OPTCL and the top of the MS rod shall be welded to the buried earth mats.

SPARES:-

The Bidder shall indicate in his Scope of Supply the entire necessary Mandatory Spares and Recommended Spares in the relevant Schedules. The variation in the quantity of Spares based on Unit Rates (Rates quoted for Mandatory Spares and Rates as mutually agreed for Recommended Spares) desired by the Owner shall be acceptable to Bidder.

MANDATORY SPARES:-

The Mandatory Spares required in next Five (5) years after Commissioning shall be included in the Bid Proposal by the Bidder. The Prices of these Spares shall be given by the Bidder in the relevant Schedule of BPS and shall be considered for Evaluation of Bid. It shall not be binding on the Employer to procure all of these Mandatory Spares. The Bidder shall clarify the Lifespan of Fifteen Years for these Spares with recommendation regarding proper storage technique for these Spares. In addition to the Mandatory Spares mentioned, any other Mandatory Spare in the opinion of the Bidder that is essentially required for smooth functioning of the Equipment, the Bidder is advised to quote for the same separately.

The Bidder is clarified that NO Mandatory Spares shall be used during the Erection and Commissioning of the Substation. The Bidder shall arrange for any of the Spares required for commissioning purpose and shall be part of supply of Main Equipment. The Bidder shall take the unutilised Spares if any brought for Commissioning purpose back.

All Mandatory Spares shall be delivered at Site at least TWO Months before Scheduled Date of Trial Operation of the Sub Station.

RECOMMENDED SPARES:-

In addition to the Spares mentioned above, the Bidder shall also provide in the Bidding Schedules a List of Recommended Spares with Item Wise Unit Prices and Total Price for Five Years of normal operation of the Plant in the Price Schedule. This List shall not take into consideration the Mandatory Spares specified in Price Schedule of this Volume and should be independent of the List of Mandatory Spares. The Owner reserves the right to buy any or all Recommended Spares.

Whenever Spares Recommended by the Bidder is the same as those under Mandatory Spares, the Price of Mandatory and such common Recommended Spares shall be the same. Further, the Price of Recommended Spares, which is not common with Mandatory Spares listed in this Specification is subject to review by the Owner and shall be finalised after mutual discussion. The Recommended Spare Parts shall be delivered at Site as per Delivery Schedule mutually agreed up on. However, the Spares shall not be dispatched before the Dispatch of the Main Equipment.

Price of Recommended Spares will not be used for Evaluation of Bids. The Price of these Spares will remain valid up to ONE (1) year after Award of Work. However, the Bidder shall be liable to provide necessary justification for the Quoted Prices of these Spares as desired by the Owner.

All the Spares supplied under this Contract shall be strictly interchangeable with the Parts for which they are intended for replacements. The Spares shall be Tested and Packed for Long Storage under the Climate Conditions prevailing at the Site, e.g. Small Items should be packed in sealed Transparent Plastic Bags with dissipater Packs as necessary. Each Spare Part shall be clearly marked or labelled

on the outside of the Packing with its description. When more than one Spare Part is packed in a single Case, a general description of the contents shall be shown on the outside of such Case and a detailed list enclosed. All Cases, Container, and other Packages must be suitably marked and numbered for the purpose of identification.

Construction Water & Power Supply:-

- Bidder shall wheel Power from the Source to the Construction Site at his own expenses whatsoever. The Power Supply availability may not be reliable. In case of failure of Power, the Bidder shall have to make his own necessary arrangements like Diesel Generator Sets etc., at his own cost so that progress of work is not affected and the Owner in no case shall be responsible for any delay in works because of non - availability of Power.
- Bidder shall make his own arrangement at his own cost and the Owner in no case shall be responsible for any delay in Works because of non -availability or inadequate availability of Water.

SPECIFIC REQUIREMENT:-

- The Bidder shall provide Battery and AC / DC Feeders for Future Bays in addition to Bays under present Scope.
- All Structures shall be designed for the worst combination of Dead Loads, Live Loads, Wind Loads as per code IS: 875, Seismic Forces (Zone – III) as per code IS: 1893 (latest), Importance Factor of 0.3, Loads due to deviation of Conductor, Load due to Unbalanced Tension in Conductor, Torsional Load due to Unbalanced Vertical and Horizontal Forces, Erection Loads, Short Circuit Forces including “Snatch” in the case of Bundled Conductors etc. Short Circuit Forces shall be calculated considering a Fault Level of 50 kA for 3 second in respect of 220kV and 31.5kA for 3 seconds for 33kV Structures. IEC: 60865 may be followed for evaluation of Short Circuit Forces.
- The Successful Bidder shall be responsible for safety of Human and Equipment during the working. It will be the responsibility of the Bidder to coordinate and obtain Electrical Inspector’s Clearance before Commissioning. Any additional Items, Modification due to observation of such Statutory Authorities shall be provided by the Bidder at No Cost to the Owner.
- EOT Crane of suitable capacity shall be provided for Erection and Maintenance of largest GIS Component/Assembly. The minimum height of Crane Hook shall be 8.0 metres or as per actual requirement whichever is higher. The Crane shall consist of all special requirements for Erection and Maintenance of GIS Equipment. The Crane shall be possible to be operated through the Cable and through the Pendant Control or Remote control, which shall be easily accessible from the floor of GIS Building.
- Site Levelling Works: The Specification of Site Levelling in all types of Soils is as follows:
 - i) Site shall be levelled / sloped by the Bidder as per drawing provided by the owner after Award of Work.
 - ii) Work covered under this Clause comprises the Site Clearance excluding cutting of trees (above girth of 30 cm.), setting out and making profiles. Earth Work in Excavation and Filling in specified area with all lifts and leads and earth work in filling with borrowed earth with all leads and lifts. Generally, spot levels shall be taken with reference to Mean Sea Level (MSL). HFL (High Flood Level) shall also be reported with reference to MSL. HFL data shall be collected in association with TFL Site Representative. The area of levelling shall be as per the approved GA Drawing. The FGL shall be at least 300 mm above HFL.
 - iii) Measurement of Earth Work in Cutting and Filling and Earth Work in filling with borrowed earth shall be in cu. M. as per SOR.
- In lieu of actual type tests, certified test reports of type tests performed on an identical unit may be submitted to owner for review and approval during bidding stage.

SECTION VI - COMMISSIONING TESTS:

GENERAL:

The list of details of the commissioning and site tests shall be prepared by the CONTRACTOR accordance with OPTCL standard and shall be submitted to the company for review and approval not less than six (6) months before the schedule date of tests.

All site test procedures, for performing the tests and test sheets used for recording the test data, to be submitted to the Owner at least 6 months prior to the start of commissioning test for review by the Owner.

The CONTRACTOR shall be responsible for providing all appropriate tools, test equipment and temporary AC and DC power supplies needed to perform the commissioning and site tests. All tests shall be performed in accordance with the applicable IEC and ANSI Standards and established practices and procedures.

The CONTRACTOR shall furnish a schedule of proposed commissioning tests at least two (2) months prior to scheduled date of tests with a list of test and commissioning equipment to be used for the PROJECT. The list shall indicate whether each equipment is owned or to be rented. Contractor shall also forward the weekly test schedule to the concerned department/division on or before Monday of every week for arranging witnessing personnel and to monitor the testing & commissioning activities.

The CONTRACTOR shall be responsible for conducting additional tests if recommended by the equipment manufacturers or by the OWNER.

The CONTRACTOR shall be responsible for commissioning the existing protection scheme involved with the scope of the subject PROJECT and commissioning tests at all involved and affected remote substations.

Testing of high voltage cable system and fiber optic cable shall be carried out to ensure that the necessary design and operation specifications are achieved prior to placing the cable system into service.

The CONTRACTOR shall be responsible to carry out all tests in a safe manner and with pre-determined safe working procedure submitted to the OWNER.

The mechanical check and visual inspection, as required OPTCL Standard shall be carried out prior to any electrical test.

In addition to the tests required in this standard, all tests required by the cable manufacturer shall be performed. In the event of a conflict between the testing requirements of this standard and those of the cable manufacturer, the OWNER shall be the sole judge as to which tests shall take precedence.

All sites testing and commissioning will be done under OWNER witness. Witnessing of testing/commissioning by OWNER does not mean acceptance of test results. Test results will be reviewed and approved by OWNER separately after CONTRACTOR submits the same for review and approval.

The test of All protective relays to be started only when the required drawings has been approved with the final protection scheme by the concern COMPANY Engineering authority and all the protective relays are to be tested using OWNER approved program controlled computerized relay test equipment. Programs for testing of all for testing all relays shall be submitted to the OWNER after completion of commissioning tests.

Protection relay setting and coordination study shall be performed by the Contractor using ETAP software and same shall be approved by OPTCL before commencement of Relay testing at site and GIS station and at remote end.

The CONTRACTOR shall perform automated calibration tests to prove the correct relay characteristics and timing operation after adjusting the relays to the settings approved by OWNER. The CONTRACTOR shall carry out calibration tests via OWNER approved computer operated test equipment using automated test routines developed by the CONTRACTOR and approved by the Manufacturer for all main protective numerical relays such as distance relays, differential relays, bus bar protection relays etc, as the proposed numerical protective relays to be used in this project are computerized and sophisticated electronic equipment, which includes scheme configuration, fault recording features, local and remote access for down loading system parameters and settings, it is requested that the CONTRACTOR should have a commissioning engineer from the relay supplier or certified by the relay supplier and Approved by the OWNER to perform the acceptance /commissioning tests for the numerical relays involve in this projects, the approval has to granted at least two months prior to start the commissioning tests. All the automated test routines and sub routines, software accessories, leads required to perform the test has to be hand over to the OWNER one set for each type of the relays.

Field tests and commissioning results shall be submitted to the OWNER not later than two (2) days after completion of tests for review prior to the final energization.

All Pre-commissioning Tests shall be carried out in accordance with OWNER's Pre- commissioning Test Procedure.

All test Equipment used for testing and Commissioning shall be calibrated and the Calibration shall be done from OWNER's approved Vendors.

SUBSTATION EQUIPMENT:

The CONTRACTOR shall perform all the applicable site commissioning tests of the new equipment installed under this PROJECT in accordance with latest IS, IEC Standards.

SAS EQUIPMENT:

CONTRACTOR shall finalize the SAS Handover Book Sheets and Test Procedures to be submitted to OWNER at least two (2) weeks before the scheduled pre-commissioning.

Pre-commissioning shall only be started if all SAS points have been completely wired.

Final commissioning shall be scheduled at least one (1) month after pre-commissioning has been successfully completed.

Technical Notes:

- 1) Drawings to be Supplied by the Contractor
- The Bidder shall construct the LILO lines, GIS switching station with all associated Civil Works and additional work as required, under supervision of Engineer-in-charge. The quality of equipment/material to be used and construction standard shall confirm to the Technical Specifications being issued with this tender.

Bidder have to procure materials/equipment strictly as per the approved vendor List provided with this tender.

The vendors for small items like cable tray, earth mat, flat, Tower accessories etc. if not provided, the same are to be bought from reputed manufactures preferably having ISI mark for such product, after ascertaining the quality and subject to confirmation of applicable IS/IEC specifications, The quality of these materials shall be assessed by the Employer's engineers at manufacturer's works and/or at site.

At every stage, Contractor has to take approval from Employer through proper channel for Bay Layout drawing, Section Elevation drawing, Key & Protection Single Line Diagram, Land Utilization Plan, Control, Protection & Metering Scheme, Cable Schedule, Earth Mat Design & drawing, all civil structures and buildings, SCADA scheme, detailed foundation drawing, structural drawings, Equipment GTP & Drawings and associated Test Reports etc. The Contractor has to coordinate with the Employer for obtaining the said approvals.

- 2) **Training of Employer's Personnel**
- The Contractor shall undertake to train, free of cost at least five (05) nos. personnel selected and sent by OPTCL at their works unless otherwise specified in the Technical Specifications. The period and the nature of training for the individual personnel shall be agreed upon mutually between the Contractor and Employer. These personnel shall be given special training in their shops and/or in their Collaborator's works and if that is not possible, in any other plant where equipment manufactured by the Contractor or his collaborator is under installation, operation, or testing to enable these personnel to become familiar with the equipment being furnished by the Contractor.

The OPTCL personnel, while undergoing training, shall be responsible to the Contractor for discipline.

- 3) **Metering, Protection & Communication**
- The Bidder shall abide by the provisions of Odisha Grid Code (OGC) Regulation 2006/Indian Electricity Grid Code (IEGC) and CEA Grid Connectivity regulations 2004, for protection, safety and communication requirements, CEA Regulation on Installation & Operation of Meters shall be the basis for implements of metering provision.

The Bidder shall abide by State Electricity Grid Code (SEGC)/Indian Electricity Grid Code (IEGC) and CEA (technical standard for construction of electrical plants and electrical line) regulation 2010 and amendment in 2015 and latest version. CEA Regulation on Installation & Operation of Meters shall be the basis for implements of metering provision. Metering Code of SEGC shall also be the basis for implementation of metering provision. The target clearance time for any fault is 160 msec. (refer clause 4.8(3)(a) of OGC). Further, the Relay setting co-ordination shall be done at state level by the Protection Coordination Committee of OPTCL, as per the provisions of section 5.2 (8) and 9.4 of OGC.

0.2s class accuracy micro-processor based energy metering system shall be installed for main and check metering system. The metering system shall be provided as per OPTCL specification, which shall be installed and commissioned under OPTCL supervision.

- 4) Supervision of all erection works by OPTCL officials:** All the survey, levelling, foundation, erection, stringing, installation, commissioning, civil and other works of EHT lines, switching station and other associated works shall be inspected by OPTCL officials as and when required, in order to ensure the quality of the works. Prior intimation of works shall be given to the concerned SDO/DGM, EHT Construction Sub-division/Division for visiting the site. Notwithstanding above, all efforts should be made by the contractors to adhere to OPTCL standards and quality while executing different works.

- 5) Statutory compliance** All statutory requirements like compliance of the applicable provisions of Standards on Grid Connectivity and Grid standards specified by CEA, IEGC, OGC and SEGC in force, PTCC approval, Inspection by the Electrical Inspectorate, Odisha and compliance of observations, OERC guidelines and norms and all other requirements as applicable under the law of the land shall be complied by the Contractor. Employer may assist for such compliance, as and when required.

- 6) Spares** All the spares for the equipment under the contract will strictly conform to the specification and documents and will be identical to the corresponding main equipment / components supplied under the contract and shall be fully interchangeable.

All the mandatory spares covered under the contract shall be supplied along with the main equipment and the delivery would be completed by the respective dates for the various categories of equipment as per the agreed Work Completion Schedule.

The quality plan and the inspection requirement finalized for the main equipment will also be applicable for the corresponding spares.

The contractor will provide Employer with the manufacturing drawings, catalogues, assembly drawings and any other document required by Employer so as to enable Employer to identify the recommended spares. Such details will be furnished to Employer as soon as they are prepared but in any case not later than six months prior to commencement of manufacture of the corresponding main equipment.

The contractor will provide Employer with all the addresses and particulars of his Vendors while placing the order on vendors for items / components /equipment covered under the contract and will further ensure with his vendors that Employer, if so desires, will have the right to place order(s) for spares directly on them on mutually agreed terms based on offers of such vendors.

Warranty for spares:

The contractor shall warrant that all spares supplied will be new and in accordance with contract documents and will be free from defects in design, materials and workmanship and shall guarantee for 24 months from the scheduled date of commercial operation of the last unit of main equipment under the contract. In case of any failure in the original component / equipment due to faulty designs, materials and workmanship, the corresponding spare parts, if any, supplied will be replaced without any extra cost to Employer unless a joint examination and analysis by Employer and the contractor of such spare parts prove that the defect found in the original part that failed, can safely be assumed not to be present in spare parts. Such replaced spare parts will have the same warranty as applicable to the replacement made for the defective original part/ component provided that such replacement for the original equipment and the spare replaced are again manufactured together. The discarded spare parts will become the property of the contractor as soon as they have been replaced by the contractor.

The contractor shall guarantee the availability of spares to Employer for the full life of the equipment covered under the contract.

Further in case of discontinuance of supply of spares by the contractor or his Vendors, the contractor will provide Employer with full information for replacement of such spares with other.

In case of emergency requirements of extra spares, the contractor would make every effort to expedite the manufacture and delivery of such spares on the basis of mutually agreed time schedule.

In case the contractor fails to supply the spares in accordance with the terms stipulated above, Employer shall be entitled to purchase the same from

alternate sources at the risk and the cost of the contractor and recover from the contractor, the excess amount paid by Employer over the rated worked out on the above basis. In the event of such risk purchase by Employer, the purchases will be as per the works and procurement policy of Employer prevalent at the time of such purchases and Employer at his option may include a representative of the contractor in finalizing the purchases.

It is expressly understood that the final settlement between the parties in terms of the relevant clauses of the Bidding Documents shall not relieve the contractor of any of his obligations under the provision of availability of spares unless otherwise discharged in writing by Employer.

7) PRE-COMMISSIONING TRIALS AND INITIAL OPERATIONS

The pre-commissioning trials and initial operations of the equipment furnished and erected by the Contractor shall be the responsibility of the Contractor as detailed in relevant clauses in Technical Specifications. The contractor shall furnish a list of all commissioning spares within 60 days from the date of FOA/letter of award and such list shall be reviewed by Employer and agreed to. However such review and agreement will not absolve the contractor of his responsibilities to supply all commissioning spares so that initial operation do not suffer for want of commissioning spares. The Contractor shall provide, in addition, test instruments, calibrating devices, etc and labour required for successful performance of these trials. If it is anticipated that the above test may prolong for a long time, the Contractor's workmen required for the above test shall always be present at Site during such trials. The cost on account of all above shall be deemed to be included in the scope of the contractor at no extra cost to Employer. These spares will be received and stored by the contractor at least three month from the schedule date of commencement of trial operation of the respective equipment/ system utilized as and when required. The utilized spares and replaced parts, if any, at the end of successful completion of performance and guarantee test shall be the property of the contractor and the he will be allowed to take these parts back at his own cost with the permission of Engineer-In- Charge.

TRIAL OPERATION:

For Trial Operation, the system for a particular package, Sub-Station and Line shall be energized in presence of the representative of OPTCL and same shall be maintained in energized condition for a period of at least twenty-four (24) hours. In case of any defect is observed, then such mutually agreed defect shall be liquidated within a maximum period of one week by the bidder. Thereafter, the system shall be maintained in energized condition.

Getting electrical inspector to inspect the plant and equipment is the responsibility of the Contractor.

8) Solving Right of Way

The contractor should adhere to policy & internationally recognized standards (Indian Standards, British Standards, IEEE and IEC standards) in design and

construction of facilities, laying of transmission lines, support infrastructure and in selection of equipment.

i) Further, the contractor's endeavor should be to avoid habitations and densely populated areas while selecting route alignment.

ii) Moreover, the contractor should also adhere to clearance norms prescribed in Indian Electricity Rules for: (a) clearance above ground for lowest conductor; (b) vertical clearance from buildings; (c) horizontal clearance from buildings; (d) minimum clearance between lines crossing each other; and (e) minimum clearance prescribed for live equipment in outdoor sub stations.

iii) The key social and environmental aspects that are / may be associated with the Project relate to Employer's environment and social assessment, corporate environmental, social and health and safety management system and their implementation. In the context of the Project, the key social and environmental issues, which will have to be managed under environment and social management system include: impacts on households due to restrictions/ constraints in the proposed ROW, crop damage and loss of trees during construction / maintenance; employee and community health and safety impact during construction and operation; community consultation and engagement; labor working conditions including employee and contract labor health and safety; impacts due to emissions to soil, air and water during construction and operation ; and potential impacts on biodiversity and cultural heritage. However, the project's impacts are mostly short term, limited to the Projects its, reversible and limited impact, if unavoidable, on environmentally sensitive areas. Further, it is possible to readily design and implement engineering and management measures to mitigate adverse impacts.

iv) The responsibilities of acquiring Right of Way (ROW) for Transmission Line lies with contractor at his risk and cost. However, Employer shall make all endeavors to facilitate process of securing the ROW. Employer shall assist the Contractor for getting clearances from Private/Govt./Statutory bodies.

9) License

i) HT/EHT LICENSE: HT/EHT license issued by the State Govt. Authority available with the Contractor is sufficient for the purpose of participation in the subject tender. In case the

HT/EHT license is not from the ELBO Odisha, Contractor license for execution of works is to be obtained from the Office of the EIC-CUM-PCEI, Odisha. However, the contractor should furnish the documents as a proof to Employer, that they have applied to the issuing authority for issuing of Contractor License within 30 (thirty) days from the issue of FOA/LOA. In case the Contractor license application is not furnished within 30(thirty) Days from the issue of FOA/LOA, Employer have the right to cancel the LOA.

ii) PROJECT LICENSE: All electrical jobs shall be carried out only through contractors possessing valid project licenses from Odisha State.

**10) OBTAINING
OF
STATUTORY
APPROVAL**

i) Unless otherwise specified in the Bidding Document, it shall be the CONTRACTOR'S sole responsibility to obtain all approvals from any authority required under any statute, rule or regulation of the Central or Odisha State Government for the performance of the contract and / or the contractual work. The application on behalf of Employer for submission to relevant authorities along with copies of required certificates complete in all respects shall be prepared and submitted by the CONTRACTOR well ahead of time so that the actual construction / commissioning of the works is not delayed for want of the approval / inspection by the concerned authorities. The CONTRACTOR shall arrange for the inspection of the works by the authorities and will undertake necessary coordination and liaison required and shall not be entitled to any extension of time for any delay in obtaining such approvals.

ii) Statutory fees, if any, paid for all such inspection and approvals shall be reimbursed at actual to the CONTRACTOR by Employer on production of documentary evidence.

iii) Any deficiency (ies) as pointed out by any such authority shall be rectified by the CONTRACTOR within the scope of relative supply and / or work at no extra cost to Employer. The inspection and acceptance of the work by such authorities shall, however, not absolve the CONTRACTOR from any of its responsibilities under this contract.

PART-2 220kV GIS

TECHNICAL SPECIFICATION FOR 220kV SF₆ GAS INSULATED METAL ENCLOSED SWITCHGEAR

CLAUSE No.	PARTICULARS
1.	GENERAL CHARACTERSTICS
2.	REFERENCE STANDARDS
3.	DEFINITIONS
4.	GENERAL DESIGN AND SAFETY REQUIREMENT
5.	CIRCUIT BREAKERS
6.	DISCONNECTORS (ISOLATORS)
7.	SAFETY GROUNDING SWITCHES
8.	HIGH SPEED MAKE PROOF GROUNDING SWITCHES
9.	INSTRUMENT TRANSFORMERS
10.	SURGE ARRESTORS
11.	OUTDOOR BUSHINGS
12.	SF ₆ GIS TO XLPE CABLE TERMINATION
13.	LOCAL CONTROL CUBICLE (LCC)
14.	ELECTRIC OVERHEAD TRAVELLING CRANE
15.	SEISMIC DESIGN CRITERIA
16.	DESIGN REVIEW
17.	TYPE TESTS
18.	MISCELLANEOUS
19.	TRANSPORT OF EQUIPMENT TO SITE
20.	PACKING, STORAGE AND UNPACKING
21.	INSTALLATION OF GIS
22.	ON SITE TESTING
23.	TESTING & MAINTENACE EQUIPMENT
24.	GIS TRAINING
25.	SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS

TECHNICAL SPECIFICATION FOR 220kV SF₆ GAS INSULATED METAL ENCLOSED SWITCHGEAR

1. GENERAL CHARACTERISTICS:

- 1.1 The SF₆ gas insulated metal enclosed switchgear shall be totally safe against inadvertent touch of any of its constituent parts. It should be designed for indoor application with meteorological conditions at site as per Section Project.
- 1.2 All parts of the switchgear and the bus ducts (for both indoor and outdoor applications) shall be 220kV system Single phase enclosure type and Bus bar shall be isolated three phase.
- 1.3 The design should be such that all parts subjected to wear and tear are easily accessible for maintenance purposes. The equipment offered shall be protected against all types of voltage surges and any equipment necessary to satisfy this requirement shall be deemed to be included.
- 1.4 The required overall parameters of GIS are as follows:-

Sl. No	Technical particulars	220kV system
1.	Rated Voltage(RMS)	245kV
2.	Rated frequency	50HZ
3.	Grounding	Effectively earthed
4.	Rated power frequency withstand Voltage (1min) line to earth (rms)	460kV
5.	Impulse withstand BIL (1.2/50/μs)	1050 KVp
6.	Switching impulse voltage (250/2500 μs)	-
7.	Rated short time withstand current (3 sec) (As applicable)	50kA/3sec (rms)
8.	Rated peak withstand current (as applicable)	135kA
9.	Rated current (at 50 degree C design ambient)	3150A
10.	Seismic level	Zone-III as per IS-1893
11.	Ambient temperature	50°C

2. REFERENCE STANDARDS

The metal-enclosed gas-insulated switchgear, including the operating devices, accessories and auxiliary equipment forming integral part thereof, shall be designed, manufactured, assembled and tested in accordance with the following International Electro-technical Commission(IEC) Publications including their parts and supplements as amended or revised as on date of bid opening:

IEC62271-203	Gas Insulated metal-enclosed switchgear for rated voltages Above 52kV
IEC62271-207	Seismic qualification for gas-insulated switchgear assemblies for rated voltages above 52 kV
IEC60376	New sulphur Hexafluoride
IEC62271- 100	High voltage alternating current Circuit breakers
IEC 62271-1	Common clauses for high voltage Switchgear and control-gear

	standards
IEC62271-102	Alternating current disconnecter (isolators) and earthing switches
IEC61869	Instrument transformer
IEC60137	Bushings for alternating voltages above 1000 V
IEC62271-209	Cable connections for gas-insulated switchgear
IEC60480	Guide to checking of sulphur hexafluoride taken from electrical equipment
IEC60099 -1/4	Non-linear resistor type arresters for AC systems
IEC60439	Factory-built assemblies of low-voltage switchgear and control Gear
IEEE80 (2000)	IEEE Guide for Safety in AC Substation grounding.
CIGRE-44	Earthing of GIS- an application guide.
IEC61639	Direct connection between Power Transformers and gas insulated metal enclosed switchgear for rated voltage 72.5 kV and above.
OISD - RP – 149	Design aspects for safety in electrical system
OISD – STD – 173	Fire prevention and protection system for electrical installations

The components and devices which are not covered by the above standards shall conform to, and comply with, the applicable standards, rules, codes and regulations of the internationally recognized standardizing bodies and professional societies as may be approved by the Purchaser and the manufacturer shall list all such applicable standards, codes etc.

3. DEFINITIONS:

- 3.1 **Assembly:** Assembly refers to the entire completed GIS equipment furnished under contract.
- 3.2 **Bay:** Bay refers to the area occupied by one Circuit Breaker and associated equipment.
- 3.3 **Compartment:** When used in conjunction with GIS equipment, compartment refers to a gas tight volume bounded by enclosure walls and gas tight isolating barriers.
- 3.4 **Enclosure:** When used in conjunction with GIS equipment, enclosure refers to the grounded metal housing or shell which contains and protects internal Power system equipment (breaker, disconnecting switch, grounding switch, voltage transformer, current transformer, surge arresters, interconnecting bus etc.)
- 3.5 **Manual Operation:** Manual operation means operation by hand without using any other source of power.
- 3.6 **Module:** When used in conjunction with GIS equipment, module refers to a portion of that equipment. Each module include sits own enclosure. A module can contain more than one piece of equipment, for example, a module can contain a disconnecting switch and a grounding switch.
- 3.7 **Reservoir:** When used in conjunction with GIS equipment reservoir refers to a larger gas-tight volume.

4. GENERAL DESIGN AND SAFETY REQUIREMENT:

- 4.1 The GIS shall be designed, manufactured and tested in accordance with the best international engineering practices under strict quality control to meet the requirement stipulated in the technical specification. Adequate safety margin with respect to thermal, mechanical, dielectric stress and insulation coordination etc. shall be maintained during design, selection of raw material, manufacturing process etc. So that the GIS provides long life with least maintenance.

The workmanship shall be of the highest quality and shall conform to the latest modern practices for the manufacture of high technology machinery and electrical switchgear.

- 4.2 The GIS assembly shall consist of separate modular compartments E.g., Circuit Breaker compartment, Bus bar compartment filled with SF₆ Gas and separated by gas tight partitions so as to minimize risk to human life, allow ease of maintenance and limit the effects of gas leaks failures & internal arcs etc. These compartments shall be designed to minimize the risk of damage to adjacent sections and protection of personnel in the event of a failure occurring within the compartments. Rupture diaphragms with suitable deflectors shall be provided to prevent uncontrolled bursting pressures developing within the enclosures under worst operating conditions, thus providing controlled pressure relief in the affected compartment.

- 4.3 The switchgear, which shall be of modular design, shall have complete phase segregation. The conductors and the live parts shall be mounted on high graded epoxy resin insulators. These insulators shall be designed to have high structural strength and electrical dielectric properties and shall be free of any voids and free of partial discharge at a voltage as per IEC62271-203 and tested accordingly. These shall be designed to have high structural and dielectric strength properties and shall be shaped so as to provide uniform field distribution and to minimize the effects of particle deposition either from migration of foreign particles within the enclosures or from the by-products of SF₆ breakdown under arcing conditions.

- 4.4 Gas barrier insulators shall be provided so as to divide the GIS into separate compartments. These shall be suitably located in order to minimize disturbance in case of leakage or dismantling. They shall be designed to withstand any internal fault thereby keeping an internal arc inside the faulty compartment. Due to safety requirement for working on this pressurized equipment, whenever the pressure of the adjacent gas compartment is reduced during maintenance, this compartment shall be designed so that it shall remain in service to perform its intended duty. The gas tight barriers shall be clearly marked on the outside of the enclosures.

The bus enclosure should be sectionalized in a manner that maintenance work on any bus disconnector (when bus and bus disconnector are enclosed in a single/three enclosure) can be carried out by isolating and evacuating the small effected section and not the entire bus. For achieving the above requirements, adequate Mechanical support and number of intermediate gas tight compartments as required, shall be provided to ensure equipment and operating personnel's safety.

The design of 220 kV GIS shall be such that in case a circuit breaker module of a feeder is removed for maintenance, both bus bars shall remain in service. Gas compartments shall be such that maintenance on one feeder may be performed without de-energising the adjacent feeders. During the fault in GIS compartment other than CB compartment, maximum of one bus bar and /or one feeder is permitted out of service for repair/maintenance.

- 4.5 The material and thickness of the enclosures shall be such as to withstand an internal flash over without burn through for a period of 300ms at rated short time withstands current. The material shall be such that it has no effect of environment as well as from the by-products of SF6 breakdown under arcing condition.
- 4.6 Each section shall have plug- in or easily removable connection pieces to allow for easy replacement of any component with the minimum of disturbance to the remainder of the equipment. Inspection windows shall be provided for disconnectors and earth switches.
- 4.7 The material used for manufacturing the switchgear equipment shall be of the type, composition and have physical properties best suited to their particular purposes and in accordance with the latest engineering practices. All the conductors shall be fabricated of copper tubes of cross sectional area suitable to meet the normal and short circuit current rating requirements. The finish of the conductors shall be smooth so as to prevent any electrical discharge. The conductor ends shall be silver plated and fitted into finger contacts or tulip contacts. The contacts shall be of sliding type to allow the conductors to expand or contract axially due to temperature variation without imposing any mechanical stress on supporting insulators.
- 4.8 Each pressure filled enclosure shall be designed and fabricated to comply with the requirements of the applicable pressure vessel codes and based on the design temperature and design pressures as defined in IEC62271-203.
- 4.9 The maximum SF6 gas leakage shall not exceed 0.5% per year for the whole equipment and for any individual gas compartment separately, and the leakage rate shall be guaranteed for at least 10 years. In case the leakage under the specified conditions is found to be greater than 0.5% after one (1) year of commissioning, the manufacturer will have to supply free of cost the total gas requirement for subsequent Ten (10) years, based on actual leakage observed during the first year of operation after commissioning.
- 4.10 Each gas-filled compartment shall be equipped with static filters, density switches, filling valve and safety diaphragm. The filters shall be capable of absorbing any water vapour which may penetrate into the enclosures as well as the by-products of SF6 during interruption. Each gas compartment shall be fitted with non-return valve connectors for evacuating & filling the gas and checking the gas pressure etc.
- 4.11 The switchgear line-up when installed and operating under the ambient conditions shall perform satisfactorily and safely under all normal and fault conditions. Even repeated operations up to the permissible servicing intervals under 100% rated and fault conditions shall not diminish the performance or significantly shorten the useful life of the switchgear. Any fault caused by external reasons shall be positively confined to the originating compartment and shall not spread to other parts of the switchgear.
- 4.12 The thermal rating of all current carrying parts shall be minimum for 3 sec. for the rated symmetrical short circuit current.
- 4.13 The switchgear shall be of the free standing, self-supporting with easy accessibility to all the parts during installation & maintenance with all high-voltage equipment installed inside gas-insulated metallic and earthed enclosures, suitably sub-divided into individual arc and gas-proof compartments preferably for:
- 1) Bus bars.
 - 2) Intermediate compartment.

- 3) Circuit breakers.
 - 4) Line Disconnectors.
 - 5) Current Transformers.
 - 6) Voltage Transformers.
 - 7) Gas Insulated bus duct section between GIS and XLPE cable.
 - 8) Gas Insulated bus duct section between GIS & Oil filled Transformer.
- 4.14 The arrangement of the individual switchgear bays shall be such so as to achieve optimum space-saving, neat and logical arrangement and adequate accessibility to all external components.
- 4.15 The layout of the substation equipment, bus bars and switchgear bays shall preferably be based on the principle of “phase grouping”. Switchgear layout based on the “mixed phases” principle shall not be accepted without mutual agreement between supplier and purchaser. The arrangement of the equipment offered must provide adequate access for operation, testing and maintenance.
- 4.16 All the elements shall be accessible without removing support structures for routine inspections. The removal of individual enclosure parts or entire breaker bays shall be possible without disturbing the enclosures of neighbouring bays.
- 4.17 It should be impossible to unwillingly touch live parts of the switchgear or to perform operations that lead to arcing faults without the use of tools or brute force. All interlocks that prevent potentially dangerous mal-operations shall be constructed such that they cannot be operated easily, i.e. the operator must use tools or brute force to over-ride them.
- 4.18 In general the contours of energized metal parts of the GIS and any other accessory shall be such, so as to eliminate areas or points of high electrostatic flux concentrations. The surfaces shall be smooth with no projection or irregularities which may cause visible corona. No corona shall be visible in complete darkness which the equipment is subjected to specify test voltage. There shall be no radio-interference from the energized switchgear at rated voltage.
- 4.19 The enclosure shall be of continuous design and shall meet the requirement as specified in clause no. 10 (special considerations for GIS) of IEEE- 80, Year- 2000. The enclosure shall be sized for carrying induced current equal to the rated current of the Bus. The conductor and the enclosure shall form the concentric pair with effective shielding of the field internal to the enclosure.
- 4.20 The fabricated metal enclosures shall be of Non Magnetic material/Aluminium alloy having high resistance to corrosion, low electrical losses and negligible magnetic losses. All joint surfaces shall be machined and all castings shall be spot faced for all bolt heads or nuts and washers. All screws, bolts, studs and nuts shall conform to metric system.
- 4.21 The elbows, bends, cross and T-sections of interconnections shall include the insulators bearing the conductor when the direction changes take place in order to ensure that live parts remain perfectly centered and the electrical field is not increased at such points.
- 4.22 The enclosure shall be designed to practically eliminate the external electromagnetic field and thereby electro-dynamic stresses even under short circuit conditions. The average intensity of electromagnetic field shall not be more than 50 micro Tesla on the surface of the Enclosure.

- 4.23 The switchgear shall have provision for connection with ground mat risers. This provision shall consist of grounding pads to be connected to the ground mat riser in the vicinity of the equipment.
- 4.24 The ladders and walkways shall be provided wherever necessary for access to the equipment.
- 4.25 The enclosure & support structure shall be designed that person of 1780 mm in height and 80 Kg in weight is able to climb on the equipment for maintenance.
- 4.26 The sealing provided between flanges of two modules / enclosures shall be such that long term tightness is achieved.
- 4.27 Alarm circuit shall not respond to faults for momentary conditions. The following indications including those required elsewhere in the specifications shall be generally provided in the alarm and indication circuits.

Gas Insulating System:

- i) Loss of Gas Density.
- ii) Any other alarm necessary to indicate deterioration of the gas insulating system.

Operating System:

- i) Low operating pressure.
 - ii) Loss of operating power.
 - iii) Loss of control supply.
 - iv) Pole Discordance.
- 4.28 The equipment will be operated under the following ambient conditions(or as defined in the section project):
- a) The ambient temperature varies between 5 degree-C and 50 degree-C. However, for design purposes, ambient temperature should be considered as 50 degree-C.
 - b) The humidity will be about 95% (indoors).
 - c) The elevation is less than 1000 metres.

- 4.29 Temperature rise of current carrying parts shall be limited to the values stipulated in IEC62271-1, under rated current and the climatic conditions at site. The temperature rise for all enclosures shall not exceed 20 degree C above the ambient temperature of 50 degree C. These conditions shall be taken into account by the supplier in the design of the equipment.

- 4.30 **Bellows or Compensating Units:** - Adequate provision shall be made to allow for the thermal expansion of the conductors & enclosures and of differential thermal expansion between the conductors and the enclosures. The bellows metallic(preferably stainless steel) with suitable provision for permitting the movement during expansion and contraction may be provided and shall be of following types:.

1. **Lateral/Vertical mounting units:** These shall be inserted, as required, between sections of bus bars, on transformer, and XLPE cable etc. Lateral mounting shall be made possible by a sliding section of enclosure and tubular conductors.
2. **Axial compensators:** These shall be provided to accommodate changes in

length of bus bars due to temperature variations.

3. **Parallel compensators:** These shall be provided to accommodate large linear expansions and angle tolerances.
4. **Tolerance compensators:** These shall be provided for taking up manufacturing, site assembly and foundation tolerances.
5. **Vibration compensators:** These bellow compensators shall be provided for absorbing vibrations caused by the transformers when connected to SF6 switchgear by oil- SF6 bushings.

The electrical connections across the bellows or compensating units shall be made by means of suitable connectors. For sliding type compensators, markers/pointers shall be provided to observe expansion or contraction during climatic conditions.

4.31 Indication and verification of switch positions: Indicators shall be provided on all circuit breakers, isolators and earth-switches, which shall clearly show whether the switches are open or closed. The indicators shall be mechanically coupled directly to the main contact operating drive rod or linkages and shall be mounted in a position where they are clearly visible from the floor or the platform in the vicinity of the equipment.

4.32 Pressure relief device : Pressure relief devices shall be provided in the gas sections to protect the gas enclosures from damage or distortion during the occurrence of abnormal pressure increase or shock waves generated by internal electrical fault arcs (preferably in downward direction).

Pressure relief shall be achieved either by means of diaphragms or plugs venting directly into the atmosphere in a controlled direction. If the pressure relief devices vent directly into the atmosphere, suitable guards and deflectors shall be provided to control direction of emission in such a way that there is no danger to the operator working in the accessible place for normal operation. Manufacturer shall submit to the owner the detailed criteria/ design regarding location of pressure relief devices/rupture diaphragms.

4.33 Pressure vessel requirements: The enclosure shall be designed for the mechanical and thermal loads to which it is subjected in service. The enclosure shall be manufactured and tested according to the pressure vessel code (ASME/CENELEC code for pressure Vessel.)

The bursting strength of Aluminium castings has to be at least 5 times the design pressure. A bursting pressure test shall be carried out at 5 times the design pressure as a type test on each type of enclosure.

Each enclosure has to be tested as a routine test at 2 times the design pressure for one minute.

4.34 **Grounding:**

4.34.1 The grounding system shall be in compliance with **IEEE-80-2000** and **CIGRE-44**, Successful Agency shall furnish specific grounding drawing for GIS, substantiating the control of hazardous voltages on the enclosures.

4.34.2 The GIS supplier shall define clearly what constitutes the main grounding bus of the GIS. The bidder shall supply the entire material for grounding bus of GIS viz., conductor, clamps, joints, operating and safety platforms etc. The bidder is also required to supply all the Earthing conductors and associated hardware material for connecting all GIS equipment, bus ducts, enclosures, control cubicles, supporting structure, GIS surge arrestor etc. to the ground bus of GIS.

- 4.34.3 The enclosure of the GIS may be grounded at several points so that there shall be grounded cage around all the live parts. A minimum of two nos. of grounding connections should be provided for each of circuit breaker, cable terminals, surge arrestors, earth switches and at each end of the bus bars. The grounding continuity between each enclosure shall be effectively interconnected externally with Copper/Aluminium bonds of suitable size to bridge the flanges. Subassembly to subassembly bonding shall be provided to bridge the gap & safe voltage gradients between all intentionally grounded parts of the GIS assembly & between those parts and the main grounding bus of the GIS.
- 4.34.4 Each marshalling box, local control panel, power and control cable sheaths and other non- current carrying metallic structures shall be connected to the grounding system of GIS via connections that are separated from GIS enclosures.
- 4.34.5 The grounding connector shall be of sufficient mechanical strength to withstand electromagnetic forces as well as capable of carrying the anticipated maximum fault current without overheating. At least two grounding paths shall be provided to connect each point to the main grounding bus. Necessary precautions should be under taken to prevent excessive currents from being induced into adjacent frames, structures of reinforcing steel and to avoid establishment of current loops via other station equipment.
- 4.34.6 All flexible bonding leads shall be tinned copper.
- 4.34.7 The Successful Agency shall provide suitable measure to mitigate Transient Enclosure Voltage (TEV) caused by high frequency currents caused by lightning strikes, operation of surge arrestor, phase to earth fault and discharges between contacts during switching operation. The grounding system shall ensure safe touch & step voltages in all the enclosures.

4.35 Gas Insulated Bus (GIB) layout:

GIB shall be designed based on the following criteria:

- (1) Maximum weight of gas in a gas tight section of GIB shall not exceed 250 Kg (for 220 kV).
- (2) The minimum outer to outer horizontal clearance between each GIS bus duct shall be 0.5 meter for 220 kV voltage level.
- (3) The minimum vertical ground clearance of GIB at road crossing shall be 5.5 meters
- (4) The GIB route inside the GIS Hall shall not obstruct easy access to GIS and control room buildings and shall not obstruct movement of crane, equipment including HV test equipment for maintenance works.
- (5) The GIB height inside the switchyard area shall be maintained at 3.5 meters from FGL.
- (6) The horizontal clearance between GIB and any other building shall be preferably three (3) metre.
- (7) For the maintenance of GIB of one circuit, only that circuit shall be isolated.

4.36 Extension of GIS:

- 4.36.1 The arrangement of gas sections or compartments shall be such as to facilitate future extension of any make without any drilling, cutting or welding on the existing equipment. To add equipment, it shall not be necessary to move or dislocate the existing switchgear bays.
- 4.36.2 As the GIS is likely to be extended in future, the supplier shall be provide the

complete design detail of interface module such as cross section, enclosure material, enclosure dimensions (inner & outer), Flange diameter (inner & outer), conductor connection arrangement, bolt spacing & dimension, rated gas pressure etc. Further GIS manufacturer supplying GIS under present scope shall furnish all the required details in addition to mentioned above necessary for design and successful implementation of an interface module during later stage while extending GIS by any other GIS manufacturer, without any help of GIS manufacturer who has supplied the GIS equipment in present scope.

- 4.36.3 The Interface module shall be designed to provide Isolating link with access hole on enclosure. The Isolating link shall be provided in such a way so that HV test can be performed on either side of the interface module separately, keeping other side of GIS remains isolated.

4.37 SF6 GAS:

The SF6 gas insulated metal-clad switchgear shall be designed for use with SF6 gas complying with the recommendations of IEC 60376, at the time of the first charging with gas. All SF6 gas supplied as part of the contract shall comply with the requirements of IEC as above as a minimum & should be suitable in all respects for use in the switchgear under all operating conditions.

The high pressure cylinders in which SF6 gas is supplied & stored at site shall comply with the requirements of following standards & regulations:

IS: 4379: Identification of the contents of industrial gas cylinders.

IS: 7311: Seamless high carbon steel cylinders for permanent & high pressure liquefiable gases. The cylinders shall also meet Indian Boilers Regulations. (Mandatory)

SF6 gas shall be tested for purity, dew point, air, hydrolysable fluorides and water contents as per IEC: 60376 and test certificates shall be furnished to the owner indicating all test results as per IEC standards for each lot of SF6 gas. Further site tests for moisture, air content, flash point and dielectric strength to be done during commissioning of GIS, Gas bottles should be tested for leakage during receipt at site.

The Successful Agency shall indicate diagnostic test methods for checking the quality of gas in the various sections during service. The method proposed shall, as a minimum check the moisture content & the percentage of purity of the gas on annual basis.

The Successful Agency shall also indicate clearly the precise procedure to be adopted by maintenance personnel for handling equipment that are exposed to the products of arcing in SF6 Gas so as to ensure that they are not affected by possible irritants of the skin and respiratory system. Recommendations shall be submitted for suitable protective clothing, method of disposal of cleaning utensils and other relevant matters.

The Successful Agency shall also indicate the details and type of filters used in various gas sections, and should also submit the operating experience with such filters.

- 4.37.1 SF6 gas monitoring devices and alarm circuits: Dial type temperature compensated gas density monitoring devices with associated pressure gauge with numerical indication will be provided. The devices shall provide continuous & automatic monitoring of gas density & separate device shall be provided for each gas

compartment so that each compartment can be monitored simultaneously as follows:

SL.	Compartments except CB	CB compartments
1.	“Gas Refill level”: This will be used to annunciate the need for the gas refilling. The GIS shall provide a contact for remote indication.	“Gas Refill level”: This will be used to annunciate the need for gas refilling. The GIS shall provide a contact for remote indication.
2.	“SF6 low level”: This will be used to annunciate the need for urgent gas filling. A contact shall be provided for remote indication	“SF6 low level”: This will be used to annunciate the need for urgent gas filling. A contact shall be provided for remote indication.
3.	This is the minimum level at which the manufacturer will guarantee the insulation rating of the assembly.	This is the minimum gas density at which the manufacturer will guarantee the rated fault interrupting capability of the breaker. At this level the breaker block contact shall operate and the closing & tripping circuit shall be blocked
4.	Not Applicable	'Zone Trip' level: This is the minimum level at which the manufacturer will guarantee the insulation rating of the assembly.

The density monitor/pressure switch contacts shall be in accordance with the above requirement.

- 4.37.2 The Successful Agency should furnish temperature v/s pressure curves for each setting of density monitor along with details of the monitoring device. It shall be possible to test all gas monitoring relays / devices without de-energizing the primary equipment & without reducing pressure in the main section. Plugs & sockets shall be used for test purposes. It shall also damp the pressure pulsation while filling the gas in service, so that flickering of the pressure switch contacts does not take place.
- 4.37.3 Gas Supply: The bidder shall include the supply of all SF6 gas necessary for filling& putting into operation the complete switchgear installation being supplied. The empty gas cylinders shall be returnable to the Successful Agency.
- 4.37.4 SF6 spare gas shall be provided 10% of total gas volume with gas cylinder.

5. CIRCUIT BREAKERS:

- 5.1 General: SF6 gas insulated metal enclosed circuit breakers shall comply with the latest revisions of IEC-62271-100 & relevant IEC except to the extent explicitly modified in the specification and shall meet with requirements specified.

Circuit breakers shall be equipped with the operating mechanism. Circuit breakers

shall be of single pressure type. Complete circuit breaker with all necessary items for successful operation shall be supplied. The circuit breakers shall be designed for high speed single and three phase reclosing with an operating sequence and timing as specified.

5.2 Duty Requirements: Circuit breaker shall be C2 -M2 class as per IEC 62271-100.

5.3 Circuit breaker shall meet the duty requirements for any type of fault or fault location also for line charging and dropping when used on effectively grounded system and perform make and break operations as per the stipulated duty cycles satisfactorily.

5.4 The circuit breaker shall be capable of:

1. Interrupting the steady and transient magnetizing current shall be suitable for up to 150MVA Power transformer.
2. Interrupting line/cable charging current as per IEC without re-strikes and without use of opening resistors. The breaker shall be able to interrupt the rated line charging current as per IEC-62271-100 with test voltage immediately before opening equal to the product of $U/\sqrt{3}$ and 1.4
3. Clearing short line fault (Kilometric faults) with source impedance behind the bus equivalent to symmetrical fault current specified.
4. Breaking 25% the rated fault current at twice the rated voltage under phase opposition condition.
5. The breaker shall satisfactorily withstand the high stresses imposed on them during fault clearing, load rejection and re-energisation of shunt reactor and/or series capacitor compensated lines with trapped charges.
6. Withstanding all dielectric stresses imposed on it in open condition at lock out pressure continuously (i.e. shall be designed for 2p.u.across the breaker continuously, for validation of which a power frequency withstand test conducted for a duration of at least 15 minutes is acceptable).

5.5 Total Break Time :The total break time shall not be exceeded under any of the following duties:

- a) Test duties T10, T30, T60, and T100 (with TRV as per IEC 62271-100).
- b) Short line fault L90, L75 (with TRV as per IEC62271-100).

The Bidder may please note that total break time of the breaker shall not be exceeded under any duty conditions specified such as with the combined variation of the trip coil voltage (70-110%), pneumatic/hydraulic pressure and SF6 gas pressure etc. While furnishing the proof for the total break time of complete circuit breaker, the Successful Agency may specifically bring out the effect of non-simultaneity between poles and show how it is covered in the total break time.

The values guaranteed shall be supported with the type test reports.

5.6 Constructional features :The features and constructional details of breakers shall be in accordance with requirements stated hereunder:

5.6.1 Contacts: All making and breaking contacts shall be sealed and free from atmospheric effects. Contacts shall be designed to have adequate thermal and current carrying capacity for the duty specified and to have a life expectancy so that frequent replacement due to excessive burning will not be necessary. Provision shall be made for rapid dissipation of heat generated by the arc on opening.

- 5.6.2 Any device provided for voltage grading to damp oscillations or, to prevent re-strike prior to the complete interruption of the circuit or to limit over voltage on closing, shall have a life expectancy comparable of that of the breaker as a whole.
- 5.6.3 Breakers shall be so designed that when operated within their specified rating, the temperature of each part will be limited to values consistent with a long life for the material used. The temperature rise shall not exceed that indicated in IEC-62271-100 under specified ambient conditions.
- 5.6.4 The gap between the open contacts shall be such that it can withstand at least the rated phase to ground voltage for eight hours at zero pressure above atmospheric level of SF₆ gas due to its leakage. The breaker should be able to withstand all dielectric stresses imposed on it in open condition at lockout pressure continuously (i.e. 2p.u. power frequency voltage across the breaker continuously)
- 5.6.5 In the interrupter assembly there shall be an adsorbing product box to minimize the effect of SF₆ decomposition products and moisture. The material used in the construction of the circuit breakers shall be such as to be fully compatible with SF₆ gas decomposition products.
- 5.6.6 Circuit Breaker shall be supplied with auxiliary switch having additional 10 NO (normally open) and 10 NC (normally closed) contacts for future use over and above those required for switchgear interlocking and other control and protection function. These spare NO and NC contacts shall be wired up to the local control cubicle.

5.7 **Operating mechanism:**

General Requirements:

- a) Circuit breaker shall be operated by spring charged mechanism. The mechanism shall be housed in a dust proof cubicle and shall have IP: 45 degree of protection.
- b) The operating mechanism shall be strong, rigid, not subject to rebound or to critical adjustments at site and shall be readily accessible for maintenance.
- c) The operating mechanism shall be suitable for high speed reclosing and other duties specified. During reclosing the breaker contacts shall close fully and then open. The mechanism shall be anti-pumping and trip free (as per IEC definition) under every method of closing.
- d) The mechanism shall be such that the failure of any auxiliary spring will not prevent tripping and will not cause trip or closing operation of the power operating devices.
- e) A mechanical indicator shall be provided to show open and close position of the breaker. It shall be located in a position where it will be visible to a man standing on the ground level with the mechanism housing closed. An operation counter shall also be provided.
- f) Working parts of the mechanism shall be of corrosion resisting material, bearings which require grease shall be equipped with pressure type grease fittings. Bearing pin, bolts, nuts and other parts shall be adequately pinned or locked to prevent loosening or changing adjustment with repeated operation of the breaker.
- g) The Successful Agency/Manufacturer shall furnish detailed operation and maintenance manual of the mechanism along with the operation manual for the circuit breaker.

Control:

- a) The close and trip circuits shall be designed to permit use of momentary-contact switches and push buttons.
- b) Each breaker pole shall be provided with two (2) independent tripping circuits and trip coils which shall be connected to a different set of protective relays.
- c) The breaker shall normally be operated by remote electrical control. Electrical tripping shall be performed by shunt trip coils. However, provisions shall be made for local electrical control. For this purpose a local/remote selector switch and close and trip control switch/push buttons shall be provided in the breaker control cubicle.
- d) The trip coil shall be suitable for trip circuit supervision during both open and close position of breaker.
- e) Closing coil and associated circuits shall operate correctly at all values of voltage between 85% and 110% of the rated voltage. Shunt trip and associated circuits shall operate correctly under all operating conditions of the circuit breaker up to the rated breaking capacity of the circuit breaker and at all values of supply voltage between 70% and 110% of rated voltage.
- f) Densimeter contacts and pressure switch contacts shall be suitable for direct use as permissive in closing and tripping circuits. Separate contacts have to be used for each of tripping and closing circuits. If contacts are not suitably rated and multiplying relays are used then fail safe logic/schemes are to be employed. Multiplying relays shall be bi-stable relays. DC supplies shall be monitored for remote annunciations and operation lockout in case of dc failures.
- g) The auxiliary switch of the breaker shall be positively driven by the breaker operating rod.

Spring operated Mechanism:

- a) Spring operated mechanism shall be complete with motor in accordance with Opening spring and closing spring with limit switch for automatic charging and other necessary accessories to make the mechanism a complete operating unit shall also be provided.
- b) As long as power is available to the motor, a continuous sequence of the closing and opening operations shall be possible. The motor shall have adequate thermal rating for this duty.
- c) After failure of power supply to the motor, one close open operation shall be possible with the energy contained in the operating mechanism.
- d) Breaker operation shall be independent of the motor which shall be used solely for compressing the closing spring. Facility for manual charging of the closing spring shall also be provided. The motor rating shall be such that it required preferably not more than 90 seconds for full charging of the closing spring.
- e) Closing action of circuit breaker shall compress the opening spring ready for tripping
- f) When closing springs are discharged after closing a breaker, closing springs shall automatically be charged for the next operation and an indication of

this shall be provided in the local control cubicle & SAS.

- g) Provisions shall be made to prevent a closing operation of the breaker when the spring is in the partial charged condition.
- h) Mechanical interlocks shall be provided in the operating mechanism to prevent discharging of closing springs when the breaker is in the closed position.
- i) The spring operating mechanism shall have adequate energy stored in the operating spring to close and latch the circuit breaker against the rated making current and also to provide the required energy for the tripping mechanism in case the tripping energy is derived from the operating mechanism.

Additional data to be furnished during detailed engineering:

- a) Drawing showing contacts in close, arc initiation, full arcing, arc extinction and open position.
- b) Data on capabilities of circuit breakers in terms of time and number of operations at duties ranging from 100 fault currents to load currents of the lowest possible value without requiring any maintenance or checks.
- c) Curves supported by test data indicating the opening time under close open operation with combined variation of trip coil voltage and hydraulic pressure.

5.8 Tests :

5.8.1 Type Tests:

- i) In accordance with the requirements stipulated under the circuit breaker along with its operating mechanism shall conform to the type tests as per IEC-62271-100.

5.8.2 Routine Tests:

Routine tests as per IEC: 62271-100 shall be performed on all circuit breakers. In addition to the mechanical and electrical tests specified by IEC, the following shall also be performed.

- i) Speed curves for each breaker shall be obtained with the help of a suitable operation analyzer to determine the breaker contact movement during opening, closing, auto- reclosing and trip free operation under normal as well as limiting operating conditions (control voltage, pneumatic pressure etc.). The tests shall show the speed of contacts directly at various stages of operation, travel of contacts, opening time, closing time, shortest time between separation and meeting of contacts at break make operation etc. This test shall also be performed at site for which the necessary operation analyzer along with necessary transducers, cables, console etc. shall be provided.
- ii) DCRM (Dynamic Contact Resistance Measurement) to be carried out for all CBs during routine test.

TECHNICAL PARAMETERS FOR CIRCUIT BREAKER:

Sl.	Parameter	220kVsystem
1.	Rated voltage kV (rms)	245
2.	Rated frequency (Hz)	50
3.	No. Of poles	3
4.	Type of circuit breaker	SF6 insulated.
5.	Rated continuous current (A) at an ambient temperature of 50°C	3150
6.	Rated short circuit capacity with percentage of DC component as per IEC-62271-100 corresponding to minimum opening conditions as specified.	50kA
7.	Symmetrical interrupting capability kA (rms)	50kA
8.	Rated short circuit making current kAp	135
9.	Short time current carrying capability for 3s, kA (rms)	50/3s
10.	Rated line charging interrupting current at 90 deg. Leading power factor angle(A rms) (The breaker shall be able to interrupt the rated line charging current with test voltage immediately before opening equal to the product of $U/\sqrt{3}$ and 1.4 as per IEC-62271-100	As per IEC
11.	First pole to clear factor	1.3
12.	Rated break time as IEC(ms)	60
13.	Total break time(ms)	65
14.	Total closing time(ms)	Not more than 200
15.	Rated operating duty cycle	O-0.3s-CO-3min-CO
16.	Reclosing	Single and Three Phase Auto Reclosing
17.	Rated insulation levels:	
	Full wave impulse withstand(1.2 /50 μ s) between line terminals and ground:	1050 kVp
	Full wave impulse withstand (1.2 /50 μ s) between terminals with circuit breaker open	1050+206 kVp
	Rated switching impulse withstand voltage (250/2500 μ s) Dry & wet.	NA

	Rated switching impulse withstand voltage(250/2500 μ s) Dry & wet Between terminals with circuit breaker open:	NA
	One minute power frequency withstand voltage between line terminals and ground	460kV rms.
	One minute power frequency withstand voltage between terminals with circuit breaker open	460+145kV rms.
18.	Max. Radio interference voltage for frequency between 0.5 MHz and 2 MHz at266kV(Micro volts)	1000 μ V
19.	No of opening operations CB is capable of performing	
	• At rated current	10000
	• At rated breaking capacity	20
20.	Max. Difference in the instants of closing/opening of contacts (ms) between poles	As per IEC
21.	Trip coil and closing coil voltage with variation as specified in Sec. GTR	220V DC
22.	Rating of Auxiliary contacts	10A at 220 V DC
23.	Breaking capacity of Aux. Contacts less than 20ms.	10A at 220 V DC
24.	System neutral earthing	Solidly Grounded
25.	• BIL Of the Breaker shall be as per Value specified in IEC 62271-203 Table 102	

6. DISCONNECTORS (ISOLATORS):

6.1 Disconnectors shall be three-pole group operated or Single-pole individual operated (as per single line diagram of the substation) and shall be installed in the switchgear to provide electrical isolation. The Disconnectors shall conform to IEC 62271-102 and shall have the ratings as specified in Technical parameters.

6.2 Construction & Design.

6.2.1 The Disconnector shall be operated by electric motor suitable for use on DC system and shall be equipped with a manual operating mechanism for emergency use. The motor shall be protected against over current and short circuit.

6.2.2 Disconnectors shall be suitable to switch the bus charging currents during their opening and closing and shall conform to viz TD1 and TD3 as per Annexure F of IEC: 62271-102 .In case the circuit breakers are provided with grading capacitors the disconnector shall be subjected to test to conform the requirements of test duty TD2. They shall also be able to make and break rated bus transfer current at rated bus transfer voltage which appears during transfer between bus bars in accordance with Annexure –B of IEC: 62271-102. The contact shielding shall also be designed to prevent re-strike and high local stresses caused by transient recovery voltages when these currents are interrupted.

6.2.3 The disconnecting switches shall be arranged in such a way that all the three phases operate simultaneously. All the parts of the operating mechanism shall be able to withstand starting torque of the motor mechanism without damage until the motor overload protection operates.

- 6.2.4 It shall be possible to operate the disconnecting switches manually by cranks or hand wheels. The contacts shall be both mechanically and electrically disconnected during the manual operation.
- 6.2.5 The operating mechanisms shall be complete with all necessary linkages, clamps, couplings, operating rods, support brackets and grounding devices. All the bearings shall be permanently lubricated or shall be of such a type that no lubrication or maintenance is required.
- 6.2.6 The opening and closing of the Disconnectors shall be achieved by either local or remote control. The local operation shall be by means of a Discrepancy control switch located in the Local Control Cubicle (LCC).
- 6.2.7 Remote control of the Disconnectors from the control room/SAS shall be made by means of remote/ local transfer switch.
- 6.2.8 The disconnect or operations shall be inter-locked electrically with the associated circuit breakers in such a way that the disconnector control is inoperative if the circuit breaker is closed.
- 6.2.9 Each disconnector shall be supplied with auxiliary switch having additional 6 NO (Normally Open) and 6 NC (Normally Closed) contacts for future use over and above those required for switchgear interlocking and automation purposes. These spare NO and NC contacts shall be wired up to the local control cubicle.
- 6.2.10 The signalling of the closed position of the disconnect or shall not take place unless it is certain that the movable contacts will reach a position in which the rated normal current, peak withstand current and short-time withstand current can be carried safely.
- 6.2.11 The signalling of the open position of the disconnector shall not take place unless the movable contacts have reached such a position that the clearance between the contacts is at least 80 percent of the rated isolating distance.
- 6.2.12 The Disconnectors and safety grounding switches shall have a mechanical and electrical interlocks to prevent closing of the grounding switches when isolator switches are in the closed position and to prevent closing of the Disconnectors when the grounding switch is in the closed position. Integrally mounted lock when provided shall be equipped with a unique key for such three phase group. Master key is not permitted.
- 6.2.13 The local control of the Isolator and high-speed grounding switches from the Local Control Cubicle (LCC) should be achieved from the individual Discrepancy control switches with the remote/local transfer switch set to local.
- 6.2.14 All electrical sequence interlocks will apply in both remote and local control modes.
- 6.2.15 Each disconnector shall have a clearly identifiable local, positively driven mechanical position indicator, together with position indicator on the local control cubicle (LCC) and provisions for taking the signals to the control room. The details of the inscriptions and colouring for the indicator are given as under :

INSCRIPTION	POSITION	COLOUR
Open position	OPEN	GREEN
Closed position	CLOSE	RED

- 6.2.16 All the disconnecting switches shall have arrangement allowing easy visual inspection of the travel of the switch contacts in both open and close positions, from the outside of the enclosure.
- 6.2.17 The disconnecting switches shall be provided with rating plates and shall be easily accessible.
- 6.2.18 The mechanical endurance class shall be M2 as per IEC 220kV Disconnectors.
- 6.2.19 Mechanical position indication shall be provided locally at each disconnector and Electrical indication at each Local Control Cubicle (LCC) / SAS.

7. SAFETY GROUNDING SWITCHES:

- 7.1 Safety grounding switches shall be three-pole group operated or single-pole individual operated (as per single line diagram of the substation). It shall be operated by DC electric motor and shall be equipped with a manual operating mechanism for emergency use. The motor shall be protected against over-current and short circuit.
- 7.2 Each safety grounding switch shall be electrically interlocked with its associated Disconnectors and circuit breaker such that it can only be closed if both the circuit breaker and disconnector are in open position. Safety grounding switch shall also be mechanically key interlocked with its associated Disconnectors.
- 7.3 Each safety grounding switch shall have clearly identifiable local positive driven mechanical indicator together with position indicator on the Local Control Cubicle (LCC) and provision for taking the signal to Control room.
- 7.4 The details of the inscription and colouring for the indicator are given as under :

INSCRIPTION	POSITION	COLOUR
Open position	OPEN	GREEN
Closed position	CLOSE	RED

- 7.5 Interlocks shall be provided so that manual operation of the switches or insertion of the manual operating device will disable the electrical control circuits.
- 7.6 Each ground switch shall be fitted with auxiliary switches having 6 NO (Normally Open) and 6 NC (Normally Closed) contacts for use by others over and above those required for local interlocking and position indication purposes.
- 7.7 Provision shall be made for padlocking/suitable locking arrangement for the ground switches in either the open or closed position.
- 7.8 All portions of the grounding switch and operating mechanism required for grounding shall be connected together utilizing flexible copper conductors having a minimum cross-sectional area of 100 sq. mm.
- 7.9 The main grounding connections on each grounding switch shall be rated to carry the full short circuit current for 3sec and shall be equipped with a silver-plated terminal connector suitable for steel strap of adequate rating for connection to the grounding grid.
- 7.10 The safety grounding switches shall conform to the requirements of IEC-62271-102 and shall have electrical endurance class: E0 & shall have mechanical endurance class M2 for 220kV voltages.
- 7.11 Combined Disconnectors & Safety grounding switch arrangement shall also be acceptable.

- 7.12 Mechanical position indication shall be provided locally at each switch and Electrical indication at each Local Control Cubicle (LCC) / SAS.
- 7.13 Continuous current rating of the grounding switches (not less than 100A) shall be specified by the manufacturer, which can be safely injected for Bay/ Bus equipment testing.

8. HIGH SPEED MAKE PROOF GROUNDING SWITCHES:

- 8.1 Grounding switches located at the beginning of the line feeder bay modules shall be of the high speed, make proof type and will be used to discharge the respective charging currents, trapped charge in addition to their safety grounding function. These grounding switches shall be capable of interrupting the inductive and capacitive currents and to withstand the associated TRV. These shall conform to class B and electrical endurance class E1 as IEC : 62271-102
- 8.2 High Speed Grounding switches shall be provided with individual/three pole operating mechanism suitable for operation from DC.
- 8.3 The switches shall be fitted with a stored energy closing system to provide fault making capacity.
- 8.4 The short circuit making current rating of each ground switch shall be at least equal to its peak withstand current rating as stated in clause 1.4 above. The switches shall have inductive/ capacitive current switching capacity as per IEC 62271-102.
- 8.5 Each high speed make proof grounding switch shall have clearly identifiable local positive driven mechanical indicator together with position indicator on the Local Control Cubicle (LCC) and provision for taking the signal to Control Room/SAS.
- 8.6 The details of the inscription and colouring for the indicator shall be as under:-

INSCRIPTION	POSITION	COLOUR
Open position	OPEN	GREEN
Closed position	CLOSE	RED

- 8.7 High speed ground switch operation should be possible locally from Local Control Cubicle (LCC)
- 8.8 These high speed grounding switches shall be electrically interlocked with their associated circuit breakers and disconnectors so that the grounding switches cannot be closed if disconnectors are closed. Interlocks shall be provided so that the insertion of the manual operating devices will disable the electrical control circuits.
- 8.9 Each high speed ground switch shall be fitted with auxiliary switches having 6 NO (Normally Open) and 6 NC (Normally Closed) contacts for use by others, over and above these required for local interlocking and position indication. All contacts shall be wired to terminal blocks in the Local Control Cubicle. Provision shall be made for padlocking the ground switches in their open or closed position.
- 8.10 All portions of the grounding switches and operating mechanism required for connection to ground shall be connected together utilizing copper conductor having minimum cross-sectional area of 100 sq. mm.
- 8.11 The main grounding connection on each grounding switch shall be rated to carry the peak withstand current rating of the switch for 3sec. And shall be equipped with a silver plated terminal connector suitable for steel strap of adequate design for connection to the grounding grid.

- 8.12 The high speed make proof grounding switches shall confirm to the requirements of IEC 62271-102.
- 8.13 Continuous current rating of the High speed grounding switches (not less than 100A) shall be specified by the manufacturer, which can be safely injected for Bay/Bus equipment testing.

TECHNICAL PARAMETERS FOR DISCONNECTORS/ ISOLATORS

S.NO	Particulars	220kV
1.	Rated voltage(rms) Un	245kV
2.	Rated frequency	50HZ
3.	System earthing	Effectively earthed
4.	Type	SF6 insulated
5.	Rated continuous current(A) at 50°C ambient temp.(as applicable)	3150(as applicable)
6.	Rated short time withstand current of isolator and earth switch	50 kA for 1 Sec.
7.	Rated dynamic short circuit withstand current withstand current of isolator and earth switch	135 kAp
8.	Rated insulation level:	
	One minute power freq. Withstand voltage: To earth :	460kV rms.
	One minute power frequency Withstand voltage: Across isolating distance	460+145kV rms.
	1.2/50 micro sec. Lighting impulse withstand voltage (+ve or -ve polarity) To earth:	1050 kVp
	1.2/50 micro sec. Lighting impulse withstand voltage (+ve or -ve polarity): Across Isolating distance.	1050+206 kVp
9.	Mechanical Endurance clause as per IEC	M2
10.	No. of spare auxiliary contacts on each isolator	6NO and 6 NC

11.	No. of spare auxiliary contacts on each Earthing switch	6NO and 6 NC
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9. INSTRUMENT TRANSFORMERS:

9.1 Current Transformers:

The current transformers and accessories shall conform to IEC: 61869-2 and other relevant standards except to the extent explicitly modified in the specification.

9.1.1 Ratios and Characteristics:

The CT core Distribution for various voltage levels. Further the numbers of cores, rating, ratios, accuracy class, etc. for the individual current transformers secondary cores shall be in accordance with this specification.

Where multi-ratio current transformers are required the various ratios shall be obtained by changing the effective number of turns on the secondary winding.

9.1.2 Rating and Diagram Plates:

Rating and diagram plates shall be as specified in the IEC specification incorporating the year of manufacture. The rated extended current rating voltage and rated thermal current shall also be marked on the name plate.

The diagram plates shall show the terminal markings and the relative physical arrangement of the current transformer cores with respect to the primary terminals (P1 & P2).

The position of each primary terminal in the current transformer SF6 gas section shall be clearly marked by two plates fixed to the enclosure at each end of the current transformer.

9.1.3 Constructional Details:

- a) The current transformers incorporated into the GIS will be used for protective relaying and metering purposes and shall be of metal- enclosed type.
- b) Each current transformer shall be equipped with a secondary terminal box with terminals for the secondary circuits, which are connected to the Local Control Cubicle. Tariff metering core Secondary terminal shall be brought out to a separate terminal box with lockable arrangement. The star/delta configuration and the interconnection to the line protection panels will be done at the CT terminal block located in the local control cubicle.
- c) Current transformers guaranteed burdens and accuracy class are to be intended as simultaneous for all cores.
- d) For 245kV class CTs, the rated extended primary current shall be 120% (or150% if applicable) on all cores of the CTs as specified in the Project.
- e) For 245kVcurrent transformer, characteristics shall be such as to provide satisfactory performance of burdens ranging from 25% to 100% of rated burden over range of 5% to 120% (or specified rated extended current whichever is higher) of rated current in case of metering CTs and up to the accuracy limit factor/knee point voltage in case of relaying CTs.
- f) The instrument security factor at all ratios shall be less than five for metering core. If any auxiliary CTs are used in the current transformers then all parameters specified shall have to be met treating auxiliary CTs as an integral part of the current transformer. The auxiliary CTs/reactor shall preferably

built in construction of the CTs.

- i. The wiring diagram, for the interconnections of the three single phase CTs shall be provided inside the Secondary terminal box.
- ii. The current transformers shall be suitable for high speed auto-reclosing.
- iii. Provisions shall be made for primary injection testing either within CT or outside.
- iv. All the current transformers shall have effective electromagnetic shields to protect against high frequency transients. Electromagnetic shields to be provided against high frequency transients typically 1-30 MHz.

TECHNICAL PARAMETERS FOR CURRENT TRANSFORMERS:

S.NO	Particulars	220kV
1.	Rated voltage (Un)	245kV(rms)
2.	Rated frequency	50Hz
3.	System neutral earthing	Effectively earthed
4.	Rated short time thermal current for 1 second (as applicable)	50kA/1sec
5.	Rated dynamic current	135kAp.
6.	Rated insulation levels:	
	1.2/50 micro second impulse voltage	1050 kVp
	One minute power frequency withstand voltage	460kV(rms)
7.	Maximum temperature rise over an ambient temperature of 50 ⁰ C	As per IEC 61869-2
8.	Radio interference voltage at 1.1 Un/ $\sqrt{3}$ and frequency range 0.5 to 2	Less than 1000 μ V
9.	One minute power frequency withstand voltage between sec.	3kV (rms)
10.	Partial discharge level	5 Pc

I. 220 kV CURRENT TRANSFORMER FOR LINE BAY:

No. of Core	Core no.	application	Current ratio	Output burden (VA)	Accuracy class	Minimum knee point voltage V _k (V)	Max CT sec Winding resistance at 75 deg c	Max Excitation current (mA) at V _k
5	1	LINE DIFF-1	1200-600-300/1	-	PS	1200 V	4	30/60.
	2	DISTANCE	1200-600-300/1	-	PS	1200 V	4	30/60.
	3	METERING	1200-600-300/1	20	0.2S	-	-	-
	4	BUS BAR PROT.	1200-600-300/1	-	PS	1200 V	4	30/60.
	5	SPARE	1200-600-300/1	-	PS	1200 V	4	30/60.

II. 220 kV CURRENT TRANSFORMER FOR TRANSFORMER BAY:

No of core	Core no.	application	Current ratio	Output burden (VA)	Accuracy class	Minimum knee point voltage V _k (V)	Max CT sec Winding resistance at 75 deg C	Max Excitation current. (mA)
5	1	TRAFODIFF	240-120-60/1 A	-	PS	1200V	4	30/60.
	2	DIR. OVER CURRENT	240-120-60/1 A	-	PS	1200V	4	30/60.

	3	METERING	240-120-60/1 A	20	0.2S	-	-	-
	4	SPARE	240-120-60/1 A	-	PS	1200V	4	30/60.
	5	BUS BAR PROT.	1200-600-300/1	-	PS	1200V	4	30/60.

III. 220 kV CURRENT TRANSFORMER FOR BUS COUPLER BAY:

No of core	Core no.	application	Current ratio	Output burden (VA)	Accuracy class	Minimum knee point voltage(Vk)	Max CT sec Winding resistance at 75 deg C	Max Excitation current. (mA)
5	1	BUS BAR PROT.	1200-600-300/1	-	PS	1200V	4	30/60.
	2	METERING	1200-600-300/1	20	0.2S	-	-	-
	3	BUS BAR PROT.	1200-600-300/1	-	PS	1200V	4	30/60.
	4	NON-DIR OVER CUR.	1200-600-300/1	-	PS	1200V	4	30/60.
	5	SPARE	1200-600-300/1	-	PS	1200V	4	30/60.

9.2 VOLTAGE TRANSFORMERS:

The voltage transformers shall conform to IEC61869-3 and other relevant standards except to the extent explicitly modified in the specification.

Voltage transformers shall be of the electromagnetic type with SF6 gas insulation. The earth end of the high voltage winding and the ends of the secondary winding shall be brought out in the terminal box.

9.2.1 **Ratios and Characteristics:** The rating, ratio, accuracy class, connection etc. For the voltage transformers shall be in accordance with technical parameters.

9.2.2 **Rating and diagram plates:** Rating and diagram plate shall be provided

complying with the requirements of the IEC specification incorporating the year of manufacture and including turns ratio, voltage ratio, burden, connection diagram etc.

9.2.3 Secondary Terminals, Earthing:

The beginning and end of each secondary winding shall be wired to suitable terminals accommodated in a terminal box mounted directly on the voltage transformer section of the SF6 switchgear.

All terminals shall be stamped or otherwise marked to correspond with the marking on the diagram plate. Provision shall be made for earthing of the secondary windings inside the terminal box.

9.2.4 The transformer shall be able to sustain full line to line voltage without saturation of transformer.

9.2.5 Constructional Details of Voltage Transformers:

- a) The voltage transformers shall be located as a separate bay module and will be connected phase to ground and shall be used for protection, metering and synchronization.
- b) The voltage transformers shall be of inductive type, non-resistant and shall be contained in their own-SF6 compartment, separated from other parts of installation. The voltage transformers shall be effectively shielded against high frequency electromagnetic transients. The supplier shall ensure that there is no risk of Ferro resonance due to the capacitance of the GIS.
- c) The voltage transformers shall have three secondary windings.
- d) Voltage transformers secondary shall be protected by Miniature Circuit breakers (MCBs) with monitoring contacts for all the windings. The secondary terminals of the VT's shall be terminated to preferably stud type non-disconnecting terminal blocks in the secondary boxes via the fuse.
- e) The voltage transformer should be thermally and dielectrically safe when the secondary terminals are loaded with the guaranteed thermal burdens.
- f) The accuracy of 0.2S on secondary should be maintained throughout the entire burden range up to 50VA on all the three windings without any adjustments during operation.
- g) The diagram for the interconnection of the VTs shall be provided inside secondary terminal box.

TECHNICALPARAMETERS FOR VOLTAGE TRANSFORMERS:

S.NO	Particulars	220kV
1.	Rated system voltage (Un)	245kV (rms)
2.	Rated frequency	50Hz
3.	System neutral earthing	Effectively earthed
4.	Short Time withstand current	50kA for 1 Second.

5.	Rated insulation levels	
	1.2/50 micro second impulse voltage	1050 kVp
	One minute power frequency withstand voltage	460kV (rms)
	250/2500micro second switching impulse voltage(dry & wet)	NA
6.	One minute power frequency withstand voltage for secondary winding	3kV (rms)
7.	Radio interference voltage at $1.1 U_n/\sqrt{3}$ and frequency range 0.5 to 2 MHz	Less than $1000\mu V$
8.	Rated total thermal burden	400 VA
9.	Partial discharge level	5 Pico coulombs.

REQUIREMENT OF VOLTAGE TRANSFORMERS (PROTECTION & METERING) LINE & BUS PTS:

Sr. No.	PARTICULARS	220 kV		
1.	Rated Primary Voltage	$220/\sqrt{3}$ kV		
2.	Type	Electromagnetic		
3.	Number of Secondaries	3		
4.	Rated Voltage Factor	1.2 continuous		
		1.5 - 30 seconds		
5.	Phase Angle Error	± 10 minutes(for metering core)		
		Sec I	Sec II	Sec III
6.	Rated Voltage (V)	$110/\sqrt{3}$	$110/\sqrt{3}$	$110/\sqrt{3}$
7.	Application	Metering	Prot.	Prot.
8.	Accuracy	0.2	3P	3P
9.	Minimum Output Burden (VA)	50	50	50

9.3 Tests:

Current and voltage transformers shall conform to type tests and shall be subjected to routine test in accordance with IEC.

10. SURGE ARRESTORS

10.1 The surge arrestors shall confirm in general to latest IEC60099-4.

10.2 Insulation co-ordination and selection of surge arrester: The successful Agency shall be fully responsible for complete insulation co-ordination of switchyard including GIS. Successful Agency shall carry out detailed studies and design calculations to evolve the required parameters locations, energy capability etc., of surge arrestors such that adequate protective margin is available between peak impulse, surge and power frequency discharge voltages and BIL of the protected requirement. The locations of surge arrestors shown in single line diagram are indicative only. If the successful Agency feels that at some more locations the surge arrestors are required to be provided the same should also be deemed included in the offer.

The successful Agency shall perform all necessary studies and the report shall detail the limits of all equipment parameters which could affect the insulation co-ordination. The report shall also detail the characteristics of the surge arrester and shall demonstrate that the selected arrester's protective and with stand levels, discharge and coordinating currents and arrester ratings and comply with the requirement of this specification.

The bidder shall also consider in the studies the open circuit breaker condition, fast transients generated by slow operation of disconnecting switches. The study report and design calculations shall be submitted for Owner's approval.

10.3 Duty requirements of GIS Surge Arrester:

10.3.1 The surge arrester shall be of heavy duty station class and gapless (Metal oxide) type without any series or shunt gaps.

10.3.2 The surge arresters shall be capable of discharging over-voltages occurring during switching of unloaded transformers, reactors and long lines.

10.3.3 245kV class arrester shall be capable of discharging energy equivalent to class 3 of IEC for 245 kV systems respectively on two successive operations.

10.3.4 The reference current of the arresters shall be high enough to eliminate the influence of grading and stray capacitance on the measured reference voltage.

10.3.5 The surge arresters are being provided to protect the followings whose insulation levels are indicated in the table given below:

Equipment to be protected	220kV System (Lightning Impulse) kVp
Power Transformer	1050
Instrument Transformer	1050
CB/Isolator Phase to ground	1050
CB/Isolator Across open contacts	1200

10.4 Constructional Features:

The nonlinear blocks shall be of sintered/inferred metal oxide material. These shall be provided in such a way as to obtain robust construction, with excellent mechanical and electrical properties even after repeated operations.

The arrester enclosure shall be vertically or horizontally mounted to suit the layout of the switchgear as suggested by the supplier and each arrester shall be fitted with an online continuous resistive leakage current monitoring system. The system shall be provided with an interface to integrate with the substation automation system.

The main grounding connection from the surge arrester to the earth shall be provided by the Successful Agency/Manufacturer. The size of the connecting conductor shall be such that all the energy is dissipated to the ground without getting overheated.

10.5 Tests:

- 10.5.1 In accordance with the requirements stipulated, the surge arrestors shall conform to type tests and shall be subjected to routine and acceptance tests in accordance with IEC document.
- 10.5.2 Each metal oxide block shall be tested for the guaranteed specific energy capability in addition to the routine/acceptance test as per IEC-60099.
- 10.5.3 Test on Surge Monitors: The Surge monitors shall also be connected in series with the test specimens during residual voltage and current impulse withstand tests to verify efficacy of the same. Additional routine/functional tests with one 100A and 10 kA current impulse, (8/20 micro sec.) shall also be performed on the surge monitor.

Technical Parameters:

S.NO	Particulars	220kV
1.	Rated system voltage	245kV
2.	System neutral Earthing	Effectively earthed
3.	Rated arrester voltage	198kV
4.	Nominal discharge current	10 kA of 8/20 μ s wave
5.	Rated frequency	50Hz
6.	Minimum discharge capability voltage corresponding to minimum discharge characteristics	10KJ/kV (referred to rated arrester)
7.	Continuous operating voltage at 50 ⁰ C	168kV
8.	Min. Switching surge residual voltage	-
9.	Max. Switching surge residual voltage	500kVp
10.	Max.Residualvoltageat5 kA	560kVp
11.	Max.Residualvoltageat10kA nominal discharge current	600kVp
12.	Max. Residual voltage at 20kA nominal discharge current	-
13.	Steep fronted wave residual voltage	650kVp 10kA
14.	Long duration discharge class	3
15.	High current short duration test value (4/10micro second wave)	100kAp
16.	Current for pressure relief test	50kA (as applicable)

17.	Prospective symmetrical fault current	50kA rms
18.	Pressure relief class:	A
19.	RIV at $1.1U_n/\sqrt{3}$ kV rms (micro volts)	Less than 500
20.	Partial discharge at 1.05 COV (pC)	Not more than 5 pC
21.	Reference ambient temp.	50°C

Note: The surge arrester rating should be in compliance with the Insulation coordination study provided by owner.

11. OUTDOOR BUSHINGS:

Outdoor bushings, for the connection of conventional external conductors to the SF6 metal enclosed switchgear.

The dimensional and clearance requirements for the metal enclosure will be the responsibility of the manufacturer and their dimensions must be co-ordinated with the switchgear. Bushings shall generally be in accordance with the requirements of IEC -60137.

- 11.1 **Insulation levels and Creepage distances:** All bushings shall have an impulse and power frequency withstand level that is greater than or equal to the levels specified for GIS.

The creepage distance over the external surface of outdoor bushings shall not be less than 31 mm/kV and in highly polluted area it shall not be less than 31mm/kV.

- 11.2 **Bushing types and fitting:** The details of bushing shall be as follows: SF6 to air Bushing shall be of Polymer / composite type and shall be robust and designed for adequate cantilever strength to meet the requirement of seismic condition, substation layout. The electrical and mechanical characteristics of bushings shall be in accordance with IEC: 60137. All details of the bushing shall be submitted for approval and design review.

Polymer / composite insulator shall be seamless sheath of a silicone rubber compound. The housing & weather sheds should have silicon content of minimum 30% by weight. It should protect the bushing against environmental influences, external pollution and humidity. The hollow silicone composite insulators shall comply with the requirements of the IEC publications IEC 61462 and the relevant parts of IEC 62217. The design of the composite insulators shall be tested and verified according to IEC 61462 (Type & Routine test).

- 11.3 **Mechanical forces on bushing terminals:** Outdoor bushings must be capable of withstanding cantilever forces due to weight of bus duct (GIB) on one side & AIS conductor/Al tube on the other side and short circuit forces. Design calculations in support of the cantilever strength chosen shall be submitted for owners review and approval.

- 11.4 Type test reports as per applicable IEC including radio interference voltage (RIV) test shall be submitted.

TECHNICAL PARAMETERS FOR SF6 BUSHING:

S.NO	Particulars	220kV
1.	Rated Voltage (kV)	245kV (rms)
2.	Rated Current (Amp)	3150
3.	1.2/50microsecondimpulse voltage (Lightning impulse withstand voltage)	1050kVp
4.	250/2500 micro second switching impulse voltage	-
5.	One minute power frequency withstand voltage	460kV
6.	Minimum total Creepage distance in mm	7595
7.	Minimum Cantilever strength (kN)	8

12. SF6 GIS TO XLPE CABLE TERMINATION:

- 12.1 The underground cables shall be connected to GIS by the interfacing of XLPE cable sealing end to GIS Cable termination enclosure.
- 12.2 The SF6 GIS to XLPE cable termination shall conform to IEC-62271-209.
- 12.3 Cable termination kit shall be in the scope of the contract. The ducts and the casing shall be suitable for the requirements for which it is designed. This interface section shall be designed in a manner which will allow ease of operation and maintenance.
- 12.4 The provision shall be made for a removable link. The gap created when the link removed should have sufficient electric strength to withstand the switchgear high voltage site tests. The GIS supplier may suggest alternative arrangements to meet these requirements. The corona rings/stress shields for the control of electrical field in the vicinity of the isolation gap shall be provided by the GIS manufacturer.
- 12.5 All supporting structures for the SF6 bus-duct connections between the XLPE cable sealing ends and the GIS shall be the scope of the contract. The supplier may specify alternative connecting & supporting arrangements for approval of the purchaser. And the support structure also should withstand the short circuit fault in case of vibration in EHV power cables.
- 12.6 The opening for access shall be provided in each phase terminal enclosures as necessary to permit removal of connectors to isolate the XLPE cables to allow carrying out the insulation tests. The general arrangement drawing of interconnecting bus-duct from GIS bay module to XLPE cable termination end shall also be submitted.
- 12.7 Type test reports of radio interference voltage (RIV) level shall be submitted for approval.
- 12.8 Cable support structure below the GIS shall NOT be fixed to the floor/ wall, instead shall be connected to GIS structure, to avoid this structure coming off the fixing during the Short Circuit.

13. LOCAL CONTROL CUBICLE (LCC):

13.1 Functions:

- 13.1.1 Each circuit-breaker bay shall be provided with a local control cubicle containing local control switches of Discrepancy switch and a mimic diagram for the operation and Discrepancy Switch /semaphore for status indication of the circuit-breaker and all associated isolators and earth switches together with selector switches to prevent local and remote and supervisory controls being in operation simultaneously.
- 13.1.2 Status indications in the LCC shall be Discrepancy Switch & semaphore type.
- 13.1.3 Closing of the circuit- breaker from the local control unit shall only be available when the breaker is isolated for maintenance purposes. Circuit-breaker control position selector, operating control switch and electrical emergency trip push button shall be installed in the Local Control Cubicle. Circuit-breaker control from this position will be used under maintenance and emergency conditions only. The emergency trip push buttons shall be properly shrouded.
- 13.1.4 If Disconnecter or earth switch is not in the fully open or closed position a "Control Circuit Faulty" alarm shall be initiated, and electrical operation shall be blocked.
- 13.1.5 20% spare terminals shall be provided in each LCC apart from terminals provided for the termination and interconnection of all cabling associated with remote and supervisory control, alarms, indications, protection and main power supply etc.
- 13.1.6 Where plugs and sockets connect control cabling between the local control cubicle and the switchgear these shall not be interchanged.
- 13.1.7 LCC shall be suitable for remote operation from substation automation system (SAS) Each gas tight compartment shall be monitored individually per phase basis through SAS

13.2 Constructional features:

- 13.2.1 Local Control cubicle shall be free standing, floor mounting type. It shall comprise structural frames completely enclosed with specially selected smooth finished, cold rolled sheet steel of thickness not less than 3 mm for weight bearing members of the panels such as base frame, front sheet and door frames, and 2.0mm for sides, door, top and bottom portions. There shall be sufficient reinforcement to provide level transportation and installation.
- 13.2.2 Access to all compartments shall be provided by doors. All fastenings shall be integral with the panel or door and provision made for locking. Cubicles shall be well ventilated through vermin-proof louvers having anti insect screen. All doors shall be gasketed all around with suitably profiled Neoprene/EPDM gaskets conforming to provision of IS 11149. However, XLPE gaskets can also be used for fixing protective glass doors.
- 13.2.3 Each LCC panel should have its own separate AC supply source feed from the ACDB. The DC supply shall be from DC Distribution board. Each panel shall be provided with necessary arrangements for receiving, distributing and isolating of DC and AC supplies for various control, signalling, lighting and space heater circuits. The incoming and sub-circuits shall be separately provided with MCBs. MCBs shall have auxiliary contact to indicate the status of the MCBs and shall be wired to alarm circuit.

- 13.2.4 Each LCC Panel shall be provided with the following:
1. **Plug Point:** 240V, Single phase 50Hz, AC socket with switch suitable to accept 5Amps and 15Amps pin round standard Indian plug, shall be provided in the interior of each cubicle with ON-OFF switch.
 2. **Interior Lighting:** Each panel shall be provided with a fluorescent lighting fixture rated for 240 Volts, single phase, 50 Hz supply for the interior illumination of the panel controlled by the respective panel door switch. Adequate lighting shall also be provided for the corridor in Duplex panels.
 3. **Space Heater:** Each panel shall be provided with a thermostatically connected space heater rated for 240V, single phase, 50 Hz AC supply for the internal heating of the panel to prevent condensation of moisture. The fittings shall be complete with switch unit
- 13.2.5 Operating mechanisms, auxiliary switches and associated relays, control switches, control cable terminations, and other auxiliary equipment shall be accommodated in sheet steel vermin proof cubicles.
- 13.2.6 Local control cubicles shall be provided to be free standing and shall be equipped with anti-condensation heaters. A suitable humidity stat and thermostat shall be included in the heater circuit.
- 13.2.7 The interior of each cubicle shall be finished with a semi-gloss white surface. An interior lamp suitable for the local LVAC supply, controlled by a door-operating switch, shall be fitted at the top of each panel.
- 13.2.8 The arrangement of equipment within cubicles shall be such that access for maintenance or removal of any item shall be possible with the minimum disturbance of associated apparatus. All the control switches shall be internal i.e. installed behind a lockable glass door.
- 13.2.9 An interlocking scheme shall be provided that takes into account the following basic requirements.
- To safeguard maintenance personnel who may be working on one section of the equipment with other sections live.
 - Prevent incorrect switching sequences that could lead to a hazardous situation to plant, equipment and personnel.
- 13.2.10 Electrical bolt interlocks shall be energized only when the operating handle of the mechanism is brought to the working position. Visible indication shall be provided to show whether the mechanism is locked or free. Means, normally padlocked, shall be provided whereby the bolt can be operated in the emergency of a failure of interlock supplies.
- 13.2.11 Where key interlocking is employed tripping of the circuit breaker shall not occur if any attempt is made to remove the trapped key from the mechanism. Any local emergency-tripping device shall be kept separate and distinct from the key interlocking.
- 13.2.12 Disconnecting switches shall be so interlocked that they cannot be operated unless the associated circuit-breaker is open except that where double bus bar arrangements are specified, on-load transfer of feeder circuits from one bus bar to another shall be made possible by interlocks which ensure that the associated bus coupler and its isolators are closed.
- 13.2.13 Bus coupler circuit breaker shall be interlocked so that it shall not be possible to

open a bus coupler circuit breaker while on load change over on that side of the breaker is in progress.

- 13.2.14 All isolating devices shall be interlocked with associated circuit-breakers and isolators in the same station so that it shall not be possible to make or break current on an isolating device unless a parallel circuit in that station is already closed.

14. ELECTRIC OVERHEAD TRAVELLING CRANE :

- 14.1 One EOT Crane for GIS hall of suitable capacity shall be provided for erection & maintenance of largest GIS component/assembly. The crane shall consist of all special requirements for erection & maintenance of GIS equipment.
- 14.2 The capacity of the crane shall be sized to lift the heaviest GIS switchgear component crane.
- 14.3 The Crane shall be used for the erection and maintenance of the GIS switchgear component and all plant installed in the GIS switchgear room .On completion of erection of the switchgear, the Successful Agency shall completely service the crane before the Taking over Certificate is issued.
- 14.4 Crane hook approaches shall be of the minimum possible dimensions to ensure maximum coverage of the plant area.
- 14.5 The crane(s) shall be capable of lifting and accurately positioning all loads ranging from full crane rated capacity to at least 10% rated capacity.
- 14.6 The crane shall have minimum speeds under full load of: Speed
- a) Hoisting 2 meters/minute.
 - b) Cross Travel 10 meters/minute.
 - c) Long Travel 20 meters/minute
 - d) Creep speed shall be of 25% of operating speed
- 14.7 The electric overhead cranes shall be provided with walkways, platforms. Guard hand rails shall be provided along the bridge rails and on the crab of EOT crane to facilitate cleaning/maintenance of the crane and to give access to the GIS room high bay lighting and ventilation duct and grilles.
- 14.8 The platform and walkways shall be designed to support any weight to be imposed upon them during crane overhaul.
- 14.9 An access platform shall be provided together with a guarded ladder on the crane to allow access to the bridge rails.
- 14.10 The crane shall be possible to be operated through the pendant control and which shall be easily accessible from the floor of GIS building and through remote control device.
- 14.11 Successful Agency shall submit the capacity calculation of crane for GIS hall considering a factor of safety of 5.
- a) The crane for 220kV GIS shall have capacity of minimum 5T safe working load & minimum lift of crane has shall be 8.0 meters or as per actual requirement whichever is higher.
- 14.12 The following tests may be EOT Crane
1. The crane shall be tested at manufacturer work under full load and 25 percent overload of hoisting and cross transverse motions as a routine test.
 2. Further the following tests may be done at site after installation of the crane at site
 - a) Check all the accessories for proper function.
 - b) No load test.

- c) Load test as per site conditions.

15. SEISMIC DESIGN CRITERIA:

- 15.1 The equipment shall be designed for operation in seismic zone for earthquake resistance the seismic loads are due to the horizontal and vertical acceleration which may be assumed to act on concurrently. Seismic Qualification requirements shall be as per IEC62271-207 for the design of equipment. The equipment along with its parts shall be strong enough and sufficiently well connected to resist total operating stresses resulting from the forces in normal operation, but in case of abnormal condition shall also resist with forces superimposed due to earthquakes. The copies of type test reports for similar rated equipment, if tested earlier, should be furnished. If the equipment has not been type tested earlier, Test Report/Analysis Report should be furnished.
- 15.2 To prevent the movement of GIS sub-assemblies i.e. various bay modules during the earthquake, suitable devices shall be provided for fixing the sub-assemblies to the foundation. The Successful Agency shall supply necessary bolts for embedding in the concrete foundation. The fixing of GIS sub-assemblies to the foundation shall be designed to with- stand the seismic events. It will also be ensured that the special devices as well as bolts shall not be over stressed. The details of the devices used and the calculations for establishing the adequacy shall be furnished by the supplier and shall be subject to the purchaser’s approval.

16. DESIGN REVIEW:

- 16.1 Design reviews shall be conducted by Owner or an appointed consultant during the detailed Engineering of the GIS; however the entire responsibility of design shall be with the supplier.
- 16.2 Owner may also visit to the supplier’s works to inspect design, manufacturing and test facilities.
- 16.3 The design review will commence after placement of award with the successful Agency and shall be finalised before commencement of manufacturing activity. These design reviews shall be carried out in detail to the specific design with reference of the GIS under the scope of this specification.
- 16.4 The design review shall be conducted generally following the, “User Guide for the application of Gas Insulator Switchgear (GIS) rated voltage of 72.5kV and above” – CIGRE report No. 125 prepared by CIGRE Working Group 23.10.
- 16.5 The manufacturer will be required to demonstrate the use of adequate safety margins for thermal, mechanical, dielectric, insulation coordination and vibration etc. design to take into the account the uncertainties of his design and manufacturing processes.
- 16.6 The scope of such a design review shall at least include the following:

1.	Dielectric Stress of Solid Insulation like Gas Barrier, support insulator etc.
2.	Dielectric stress of SF6 Gas Volume.
3.	Mechanical strength of enclosure, expansion joints etc.
4.	Criteria for providing expansion joint.

5.	Sealing system
6.	Thermal stress and resulting increase in gas pressure during short circuit condition.
7.	Earthing of enclosure W.R.T circulating current.
8.	Seismic design, as per IEC 62271-207.
9.	Circuit Breaker.
10.	Isolator and Earth switch.
11.	Voltage transformer.
12.	Current Transformer.
13.	Surge Arrester.
14.	Bushing.
15.	Ducting.
16.	Corrosion protection.
17.	Electrical and physical Interfaces with substation.
18.	Testing capabilities.
19.	Inspection and test plan.
20.	Transport and storage.
21.	Maintainability.
22.	Site Test.

16.7 Further, the manufacturer shall furnish the following information

- a) Details regarding the loosely distributed metallic particles within the GIS encapsulation and calculations of critical field strength for specific particles of defined mass and geometry.
- b) The calculations and documents in support of the average intensity of electromagnetic field on the surface of the enclosure above during detailed engineering.
- c) The detailed criteria/design regarding location of pressure relief devices/rupture diaphragms
- d) Calculations to show that there is no Ferro resonance due to capacitance of GIS for the voltage transformers
- e) Design calculation for simulated parameters for Seismic level as applicable.
- f) Insulation Coordination studies including studies to recommend for additional surge arrestor.
- g) Calculations in support of touch & step voltages in all enclosures and earthing of complete GIS installation.
- h) Measures to mitigate **Transient Enclosure Voltage** by high frequency currents.
- i) Calculation for providing bus duct supports.
- j) Gas handling procedure.

- k) Capacity calculation for EOT Crane for the GIS hall considering factor safety 5.0.
- l) Method statement/ procedure for conduction High Voltage test with PD measurement after installation at site.

17. TYPE TESTS:

The offered GIS equipment shall conform to the type tests as per IEC-62271-203. Successful Agency shall submit valid type test reports for the following type tests & additional type tests.

Sl. No:	Description of the Type Test for GIS
1.	Tests to verify the insulation level of the equipment and dielectric test on auxiliary circuits
2.	Tests to prove the temperature rise of any part of the equipment and measurement of the resistance of the main circuit
3.	Tests to prove the ability of the main and earthing circuits to carry the rated peak and rated short time withstand current
4.	Tests to verify the making and breaking capacity of the included switching devices
5.	Tests to prove the satisfactory operation of the included switching devices
6.	Tests to prove the strength of the enclosures
7.	Gas tightness tests
8.	Tests on partitions
9.	Tests to prove the satisfactory operation at limit temperatures
10.	Tests to assess the effects of arcing due to internal fault
11.	Verification of the degree of protection of the enclosure
12.	Tests to prove performance under thermal cycling and gas tightness tests on insulators
13.	Additional tests on auxiliary and control circuits
14.	Reactor current switching test
15.	Test to demonstrate the Power frequency withstand capability of breaker in open condition at lock out pressure.
16.	Electromagnetic compatibility tests (if applicable)
17.	Radio inference voltage tests (RIV)

The test reports of the above type tests for GIS (including type test report on Circuit breaker, Disconnectors, Grounding switches, Current and Voltage transformers as per relevant IEC and type tests of SF6/Air & Oil bushing as per IEC 60137 shall be submitted for approval as per Section project, Technical Specification.

18. MISCELLANEOUS:

18.1 **Painting of enclosure:** All enclosures shall be painted externally as per manufacturer's painting procedure. The painting procedures as followed shall be submitted during detailed engineering.

18.2 Identification & rating plate:

Each bay shall have a nameplate showing:

- a) A listing of the basic equipment (such as a breaker, Disconnectors, grounding switches, current transformers, voltage transformers, and bushings etc.,)
- b) A schematic diagram indicating their relative locations.
- c) TFL/OPTCL Contract Number.
- d) Each module will have its own Identification & rating plate. The rating plate marking for each individual equipment, like Circuit breaker, Disconnectors Grounding switches, Current transformer, Voltage transformers, Surge arrester etc., shall be as per their relevant IEC.

19. TRANSPORT OF EQUIPMENT TO SITE:

The successful Agency shall be responsible for the loading, transport, handling and offloading of all equipment and materials from the place of manufacture or supply to site. The successful Agency shall be responsible to select and verify the route, mode of transportation and make all necessary arrangement with the appropriate authorities as well as determining any transport restrictions and regulations imposed by the government and other local authorities. All transport packages containing critical units viz, Circuit breakers and Voltage transformers shall be provided with sufficient number of electronic impact recorders (on returnable basis) during transportation to measure the magnitude and duration of the impact in all three directions. The acceptance criteria and limits of impact in all three directions which can be withstood by the equipment during transportation and handling shall be submitted by the successful Agency during detailed engineering. The recording shall commence in the factory and must continue till the units reach site. The data of electronic impact recorders shall be downloaded at site and a soft copy of it shall be handed over to Engineer – in –charge. Further, successful Agency shall communicate the interpretation of the data within three weeks.

20. PACKING, STORAGE AND UNPACKING:

- 20.1 All the equipment shall be carefully packed for transport by sea, rail and road in such a manner that it is protected against the climatic conditions and the variations in such conditions that will be encountered en route from the manufacturer's works to the site.
- 20.2 The SF6 metal clad equipment shall be shipped in the largest factory assembled units that the transport and loading limitations and handling facilities on site will allow to reduce the erection and installation work on site to a minimum.
- 20.3 Where possible all items of equipment or factory assembled units shall be boxed in substantial crates or containers to facilitate handling in a safe and secure manner. Should the units be considered too large for packing in crates, they shall be suitably lagged and protected to prevent damage to any part, particularly small projections, during transport and handling. Special lugs or protective supports shall be provided for lifting to prevent slings and other lifting equipment from causing damage. Each

- crate, container or shipping unit shall be marked clearly on the outside to show where the weight is bearing and the correct position for the slings.
- 20.4 Each individual piece to be shipped, whether crate, container or large unit, shall be marked with a notation of the part or parts contained therein.
- 20.5 Special precautions shall be taken to protect any parts containing electrical insulation against the ingress of moisture. This applies particularly to the metal clad equipment of which each gas section shall be sealed and pressurized prior to shipping. Either dry nitrogen/air or dry SF₆ gas shall be used and the pressure shall be such as to ensure that, allowing for reasonable leakage, it will always be greater than the atmospheric pressure for all variations in ambient temperature and the atmospheric pressure encountered during shipment to site and calculating the pressure to which the sections shall be filled to ensure positive pressure at all times during shipment. The type of gas, the maximum pressure to which sections will be filled prior to shipment and the minimum allowable pressure during shipment shall be advised prior to dispatch.
- 20.6 All blanking plates, caps, seals etc., necessary for sealing the gas sections during shipment to site shall be provided as part of the contract and shall remain the property of TFL/OPTCL. If considered necessary, blanking plates or other sealing devices shall be provided with facilities for measuring the gas pressure and recharging at any time during the transport period. Any seals, gaskets, 'O' rings, etc. that may be used as part of the arrangement for sealing off gas sections for shipment of site, shall not be used in the final installation of the equipment at site. Identification serial numbers shall be stamped into the blanking plates, etc., and on the switchgear equipment to which they are fitted so that they can easily be identified and refitted should it ever be necessary to ship sections of the switchgear back to the manufacturer's works for repair.
- 20.7 Valves and other gas couplings associated with the switchgear gas systems shall be adequately protected against damage from any bumps or physical blows. They shall also be capped to prevent ingress of dirt or moisture or damage to any coupling, pipes, threads or special fittings. Any explosion vents and other pressure relief devices shall be suitably sealed and protected to prevent accidental exposure of the sealed sections during shipment to site.
- 20.8 For bus ducts involving male and female joints of the current carrying conductor, the same shall be transported in disassembled condition to avoid any damage during transit. All bright parts liable to rust shall receive a coat of anti-rusting composition and shall be suitably protected.
- 20.9 The successful Agency will be able to use the available storage areas at site. The successful Agency shall ensure that during the period between arrival at site and erection, all materials and parts of the contract works are suitably stored in such approved manner as to prevent damage by weather, corrosion, insects, vermin or fungal growth. The scope of providing the necessary protection, storing off the ground, as required etc. is included in the works to be performed by the successful Agency.
- 20.10 The equipment shall only be unpacked or removed from the containers immediately prior to being installed. They shall not be left lying unnecessarily in open crates or containers. Special precautions shall be taken when gas sections which have been sealed and pressurized for shipping are opened up to reduce the ingress of dirt and atmospheric moisture to a minimum. Whenever possible this shall only be done immediately prior to installation and if any section is to be left

outside for any length of time after being opened, it shall be resealed and pressurized with either dry nitrogen/air or SF₆ gas until required.

21. INSTALLATION OF GIS:

- 21.1 Civil works of GIS Hall shall be completed in all respects for taking up the installation and it shall be ensured that all dust and dirt in the hall are removed. All openings (including Bus Duct) except entry door should be closed and proper sealed
- 21.2 The installation area shall be secured against entry of unauthorized personnel. Only certified manufacturer's engineer and supervisor shall supervise critical & important erection works. The help of local technicians can be taken only for material handling and non-critical erection works. Engineers and supervisors of the manufacturer shall submit authorization and competency certificate to TFL/OPTCL.
- 21.3 Assembly drawing for GIS erection for the section under progress shall be available and displayed in GIS hall at the time of work.
- 21.4 Working personnel shall clean their shoes or apply covers on shoes before entering the immediate working area. The working clothes of authorized personnel shall be made of non-fluffy material.
- 21.5 GIS hall door shall have automatic close facility after entry of personnel to avoid dust and moisture entry. Walls and ceiling shall be in a condition so that neither dirt nor plaster might fall or rub off and formation of condensation water in ceiling shall be prevented under any circumstances.
- 21.6 Floor in the installation area shall have a firm surface and shall be kept dust free with a vacuum cleaner. Vacuum cleaning to be done at regular interval throughout the day with separate team of persons assigned for cleaning work only.
- 21.7 Only T&P and consumables required for GIS erection shall be kept in GIS during erection.
- 21.8 In case of outdoor installation of GIS or of GIS components open gas compartments shall be protected from dust and moisture ingress (by tarpaulin covers etc.,)
- 21.9 Bus duct exit in the GIS hall wall shall be kept covered by suitable means until permanent cover is provided after installation of bus ducts.
- 21.10 A separate room shall be identified in consultation with TFL/OPTCL for carrying out repair works/ small part assembly and the room shall be weather protected and lockable. All excess material (not required for immediate installation works) test equipment and tools and tackles to be stored separately from GIS hall in the separate room for rework
- 21.11 All assembly work shall be done by qualified personnel only who are to be identified and list submitted to TFL/OPTCL site before starting of erection work.
- 21.12 Erection agency shall submit method statement and make available formats for checking during each stage of hall preparation, assembly process and final checks to be approved by TFL/OPTCL site before start of erection. Method statement shall include record of shock/ impact recorder at the time of unpacking. Shock recorder down loaded data and analysis shall be submitted before commencement of erection work. In case of violation of shock limits, expert form manufacturer shall visit and do the internal inspection before giving clearance for erection.

- 21.13 Cleaning is of utmost importance and hence before assembly, all the loose metal parts, subassemblies and all contact & sealing surfaces shall be cleaned before installation. Cleaning shall be carried out with specified cleaning agents of the manufacturer in no condition water is to be used except for external surfaces. Further, prior to opening, gas compartment shall be thoroughly cleaned and vacuum cleaning of the installation area shall also be done specially the immediate vicinity of the flanges to be connected. Dust disturbance in the area to be avoided
- 21.14 Also, before closing a flange connection clean the immediate vicinity and all accessible parts of the components shall be connected with a vacuum cleaner
- 21.15 Once the transport covers are removed, installation of flanges shall be done without any interruptions, if interruptions cannot be avoided open flanges are to be covered with clean plastic foil. Transport covers, O-rings and other packing material shall be taken out of GIS after immediately after removal.
- 21.16 O Rings shall be properly stored and taken out only before installation. O Rings are also to be cleaned before use with manufacturer authorized cleaning agent.
- 21.17 At all points of time during installation authorized personnel shall use disposable gloves to avoid contamination.
- 21.18 Cable termination work shall commence only after completion of GIS equipment as during GIS installation period laying and termination of cables interferes with the GIS erection work and affects cleanliness.
- 21.19 Approved Field Quality Plan shall be followed strictly during site work.

22. ON SITE TESTING:

After the switch gear has been completely installed on site and filled with SF₆ gas, the complete assembly shall be subjected to the site tests as per IEC62271-203 and with the test voltages specified below:-

- 22.1 The adequacy of number of UHF sensors and their location shall be verified as per recommendations of CIGRE task force TF 15/33.03.05 (Task force on Partial discharge detection system for GIS: Sensitivity verification for the UHF method and the acoustic method). In case during site testing additional UHF sensors are required, the same shall also be supplied and installed to complete the technical requirement.
- 22.2 Application of AC voltage equal to 1.2 times the service voltage in order to condition the GIS whilst at the same time permitting measurement of Partial discharge and detection of conductive particles by UHF method.
- 22.3 In case of a disruptive discharge in the gas as outlined in clause no: C.6.2.2 Procedure b) annexure – C of IEC: 62271-203, and a repeat test is performed due to failure during the AC voltage test, then the test shall be carried out at 1.2 times the service voltage.
- 22.4 The analysis of PD measured during High voltage test shall be done very carefully and presence of PD measured by any sensor shall be attended and HV test shall be repeated after the rectification work. Calibration of PD sensors shall be completed before start of HV test to establish reference for detection of PD above 5 pc.
- 22.5 Method statement/ procedure of onsite high voltage testing and PD measurement shall be submitted by successful Agency in advance.
- 22.6 On site testing: Pre-commissioning test procedure for GIS shall be submitted for

TFL/OPTCL approval.

23. TESTING & MAINTENANCE EQUIPMENT:

All testing & maintenance equipment shall be offered, if specified as per relevant schedule.

23.1 SF6 Gas leakage detector.

The detector shall be portable, battery operated with built in battery charger, hand held type and having a minimum SF6 gas leakage sensitivity of 5gm/year. The sensor shall be connected through a flexible wand for easy accessibility to joints, seals and couplings in GIS equipment and provided with a protection filter. The equipment shall have on/off switch & suitable indicating lamps/LEDs, variable pitch audible signal for leakage indication, and ahead phone jack. The equipment shall have automatic zeroing of background signals suitable for detecting SF6 gas leakage in charged switchyard. The test kit shall be compatible for EMI/EMC environment as per IEC 1000.

23.2 Gas filling and evacuating plant :

23.2.1 The plant necessary for filling and evacuating the SF6 gas in the switchgear shall be supplied to enable any maintenance work to be carried out. This shall include all the necessary gas cylinders for temporarily storing the evacuated SF6 gas. The capacity of the temporary storage facilities shall at least be sufficient for storing the maximum quantity of gas that could be removed from at least one phase of one complete bay (switchgear and associated equipment).

23.2.2 Where any item of the filling and evacuating plant is of such a weight that it cannot easily be carried by maintenance personnel, it shall be provided with lifting hooks for lifting and moving with the overhead cranes.

23.2.3 The minimum capacity of evacuation plant will be as under: Vacuum Pump: 60 M3/Hour (Nominal suction pressure) Compressor: 15 M3/hour(Delivery)

23.2.4 The evacuation equipment shall be provided with all the necessary pipes, couplings, flexible tubes and valves for coupling up to the switchgear for filling or evacuating all the gases.

23.2.5 The gases compartments shall preferably be fitted with permanent non-return valves through which the gas is pumped into or evacuated from the compartments. Detail of the filling and evacuating plant that will be supplied, as well as the description of the filling and evacuating procedures shall be furnished.

23.3 SF6 gas analyser:

The SF6 gas analyser should be of portable type and instruments shall have following features:

- a) In-built calibration facility.
- b) Sensitivity of the equipment shall not be affected by any atmospheric conditions like dust, humidity, heat, wind etc.
- c) Equipment shall work on zero gas loss principle i.e. gas should be pumped back to the compartment after measurement without any exposure to the atmosphere.
- d) Equipment shall be supplied with suitable regulator which can be used to connect SF6 cylinder if required.

- e) Following acidic/impurities products should be detected as per IEC 60480, IEC 60376 and IEC-1125
 - i. SF6 purity – Range: 0-100 % & Accuracy: +/- 0.5 %
 - ii. Dew point - Range : -60 to +20 deg C & Accuracy: +/- 0.5 deg C
 - iii. SO2 - Range : 0-150 PPM & Accuracy : +/- 2 %
 - iv. CF4 – Range : 0-60% vol & Accuracy : +/- 1 %
 - v. HF - Range : 0-200 PPM & Accuracy : +/- 5 %
- f) Instrument should work on AC source as well as on rechargeable battery
- g) Input pressure: up to 10 bar.
- h) It should be housed in a robust IP67 case with wheels

23.4 Portable Partial Discharge (PD) monitoring system:

- 23.4.1 The equipment shall be used for detecting different types of defects in Gas Insulated Stations (GIS) such as Particles, Loose shields and Partial Discharges as well as for detection of Partial discharges in other types of equipment such as Cable Joints, CTs and PTs.
- 23.4.2 It shall be capable for measuring PD in charged GIS environment as EHV which shall have bandwidth in order of 100 MHz–2GHz with possibility to select a wide range of intermediate bandwidths for best measurement results. The principle of operation shall be based on UHF principle of detection. The instrument should also be able to detect partial discharges in cable joints and terminations.
- 23.4.3 Detection and measurement of PD and bouncing particles shall be displayed on built in large LCD display and the measurement shall be stored in the instrument and further downloadable to a PC for further analysis to locate actual source of PD such as free conducting particles, floating components, voids in spacers, particle on spacer surfaces etc. Software for display and diagnosis of PD signals and an expert software system for accurate interpretation of cause of PD shall also be supplied and installed by the successful Agency.
- 23.4.4 The equipment shall meet the following requirements
 - a) Measurement shall be possible in noisy environment.
 - b) Stable reading shall be possible in presence of vibrations within complex GIS assemblies, which can produce signals similar to PD.
 - c) Equipment should have necessary synchronizing circuits to obtain PD correlation with power cycle and power frequency.
 - d) The equipment shall be battery operated with built-in-battery charger. It shall also be suitable for 230V AC/50 Hz input.
 - e) Measurement shall be possible in the charged switchyard in the presence of EMI/EMC. Supplier should have supplied similar detector for GIS application to other utilities. Performance certificate and the list of users shall be supplied along with the offer.
 - f) Instrument shall be supplied with standard accessories i.e., re-locatable sensors with mounting arrangements, connecting cables (screened) to sensors, Lap top PC, diagnostic and expert interpretation software, carrying case, rechargeable battery pack with charger suitable for 230V AC, 50Hz supply connecting cables (duly screened) to view in storage.
 - g) The function of software shall be covering the following:

- i. Data recording, storage and retrieval in computer.
 - ii. Data base analysis.
 - iii. Template analysis for easy location of fault inside the GIS.
 - iv. Evaluation of PD measurement i.e., Amplitude, Phase Synchronization etc.
 - v. Evaluation of bouncing/loose particles with flight time and estimation on size of particle.
 - vi. Expert software system for accurate interpretation of cause of PD.
 - vii. Report generation.
- h) To prove the suitability in charged switchyard condition, practical demonstration shall be conducted before acceptance.
 - i) Supplier shall have “Adequate after sales service” facility in India.
 - j) Necessary training may be accorded to personnel to make use of the kit for locating PD sources inside the GIS.
 - k) Instrument shall be robust and conform to relevant standard.

23.4.5 Calibration:

The UHF Couplers have to be first calibrated as per CIGRE procedure TF 15/330305 as part of factory acceptance tests to guarantee detection sensitivity of 5pC or better. The GIS of same design shall be used as test specimen during the coupler calibration. The pulse injection level determined through above factory calibration tests shall only be used as reference for site sensitivity checks during commissioning of PDM system. The data sheet/frequency response characteristics shall be submitted for reference.

23.4.6 Pulse generator for UHF sensor sensitivity test shall also be supplied as a standard accessory.

24. Training of purchaser’s Personnel (GIS TRAINING):

24.1 Training at Manufacturer’s works:

The successful Agency shall arrange for training of 2 persons (OPTCL Engineers) at the manufacturer’s works of GIS for 5 working days in Design, manufacturing and testing of GIS being supplied. The travelling, lodging, boarding & visa arrangement including all expenses shall be made by the successful Agency for the above training.

24.2 Training at Site:

The successful Agency shall arrange for training of 4 persons (OPTCL Engineers) including operating field staff of Employer for five working days at sub-station in operation and maintenance of GIS. The expenses for training including travelling, lodging, boarding of the trainer shall be borne by the successful Agency.

Training of four (4) persons (OPTCL Engineers) on construction, installation, commissioning and O&M shall be arranged by successful Agency at free of cost. Duration of the complete training shall be 7 working days, covering minimum below specified curriculum. Any other specific area may be brought to notice and included.

1. General Explanation for GIS
2. Layout and Architecture of GIS
3. Gas Sectionalisation of GIS

4. Construction of CB
5. Operating Mechanism of CB
6. Maintenance of CB
7. Overhaul of CB (Interrupting chamber)
8. Overhaul of CB (Operating Unit)
9. Construction of DS/ES
10. Maintenance of DS/ES
11. Overhaul of DS/ ES
12. Construction of Bus/ Cable head/ SF6 – air bushing
13. Maintenance of Bus/ Cable head/ SF6 – air bushing
14. Overhaul of Bus/ Cable head
15. Overhaul of various transformer connections
16. Operation of GIS with SCADA
17. Construction & Maintenance of Lightning Arrester
18. Construction & Maintenance of VT/CT
19. Construction & Maintenance of Local control panel
20. Erection of GIS at site.
21. Installation & Testing of GIS at site
22. Type tests of GIS
23. Routine tests of GIS.
24. Faults simulation of GIS
25. Localization of GIS fault.

**25. SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS
FOR 245 kV SF6 GAS INSULATED SWITCHGEAR**

DESCRIPTION	SPECIFICATION REQUIREMENT	To be filled up by the Bidder
COMMON		
. Type	M2	
. Standards	IEC	
. Rated voltage kV	245	
. Normal service voltage kV	220	
. Lighting impulse withstand voltage:		
- at nominal gas pressure kV peak	--	
- at minimum gas pressure kV peak	1050	
. Power frequency withstand voltage		
- at nominal gas pressure kV	--	
- at minimum gas pressure kV	460	
. Short time withstand current kA	50	
. Duration of short time current S	3	
. Peak withstand current kA peak	135	
. Normal current at 50° C:		
- Bus bar A	3150	
- Bays A	3150	
. Insulation medium	SF ₆	
. Rated pressure of SF 6 insulation.		
- at 20 C ambient bar	-	
. Maximum pressure :		
- at 50 C ambient bar	-	
. Setting of pressure relief device bar		
- 1 st level low pressure (refilling) at 20 C	-	
- 2 nd level low pressure (pressure failure) at 20 C	-	
. Admissible power frequency voltage at atmospheric SF6 pressure kV	460	
. Material of conductor	-	
. Material of enclosures	Aluminum alloy	
. Material of insulators	Epoxy resin	
. Pressure design of enclosure	-	
. Max relative leakage %	0.5%/year	
. Enclosures :		
. Type of enclosure	1 phase or 3 phase	
. Material	Aluminum alloy	

DESCRIPTION	SPECIFICATION REQUIREMENT	To be filled up by the Bidder
. Shape of enclosure		
- Minimum thickness and diameter of enclosure		
. Degree of protection	IP65	
. Burn through time due to internal arc	0.3s	
. Resistivity		
. Temperature rise over ambient of 45 C / design temperature of enclosure.		
- At rated current	$\leq 30^{\circ}\text{c}$	
- short circuit current flows for 3 Second.	$\leq 60^{\circ}\text{c}$	
. Each Gas Compartment :		
. Design pressure	-	
. Minimum bursting pressure	40bar	
. Routine test pressure	16bar	
. Leakage test pressure	6bar	
. Type of pressure relief device	Metallic Bursting disc	
. Material pressure relief device	Metal	
. Setting of pressure relief device	-	
. Rated density of gas		
. Minimum gas density		
. Volume of gas		
. Insulator :		
. Material of insulator	Epoxy resin	
. P.D. Level (PC)	≤ 5	
. Any special design to protect insulator from the deteriorating effect of sf6 decomposed gases	There are shields in insulator to uniform the electric field	
. Circuit breakers		
. Maker name and country of manufacturer	-	
. Type	M2	
. Standards	IEC	
. Short circuit breaking current KA	50	
. Short circuit making current KV peak	135	
. Power frequency withstand voltage		
- across opening distance KV rms	460+145	
. Lighting impulse withstand voltage :		

DESCRIPTION	SPECIFICATION REQUIREMENT	To be filled up by the Bidder
- across opening distance KVp	1050+206	
. Normal current at 45 C A	3150	
. Insulation medium	SF ₆ gas	
. Rated pressure of SF 6 insulation :		
- at 20 C ambient bar	-	
. Maximum pressure :		
- at 45 C ambient bar	-	
. Setting of pressure relief device bar		
- 1st level low pressure (refilling) at 20°C	-	
- 2nd level low pressure (pressure failure) :	-	
. First pole to clear factor	1.3	
. Rated operating duty cycle	O-0.3s-CO-3min-CO	
. Rated transient recovery voltage KV peak	375/288/515 Or as per IEC	
. Rated out of Phase breaking current KA	12.5	
. Rated cable charging breaking current A	250	
. Rated characteristics for short line faults-KA	L75:30 L90:36	
. Rated line charging breaking current A	160	
. Rated transformer charging breaking current A		
. Operating mechanism type	Spring	
. Motor voltage Vdc.	220V	
. Motor power W	-	
. Rated power of closing coil W	440W/220V DC	
. Rated power of tripping coil :		
. normal trip W	440W/220V DC	
- emergency trip W	440W/220V DC	
. Closing time : (ms)	≤ 100	
- tolerance (ms)	--	
. Dead time : (ms)	100	
- tolerance (ms)	--	
. Break time (ms)	≤ 60	
- tolerance (ms)	--	
. Make time (ms)	≤ 60	
- tolerance (ms)	--	

DESCRIPTION	SPECIFICATION REQUIREMENT	To be filled up by the Bidder
. Arcing time (ms)		
- tolerance (ms)	--	
. Synchronism (ms)	≤3	
. Number of breaks in series (per phases)	1	
. Number of auxiliary contacts		
- NO	-	
- NC	-	
. Pressure design enclosure	-	
. Material contacts		
- main	Copper, silver	
- arcing	Copper-tungsten	
. Whether CB is re strike free	Yes	
. Breaker is fixed with trip coils and closing coils		
- No. of trip coils and closing coils	2 trip and 1 closing	
. No. of opening operations CB is capable of performing		
- at rated current	2000	
- at rated breaking capacity	20	
-without inspection, replacement of contacts or other main parts without replacing/ reconditioning SF6 gas	10000	
- No. of operations after which routine inspection / maintenance of CB is necessary	10000	
. Maximum temperature rise over ambient temperature of 45 C		
- Main current carrying part in SF 6 gas		
- Operating coils		
- Operating motor		
. Thickness of Silver plating for Contacts.		
. Overvoltage corresponding to (cable charging, line charging, transformer charging, out of phase current)		
. Disconnectors		
. Maker name and country of manufacturer	-	
. Type	M2	
. Standards	IEC	
. Characteristics	Live off-Load operation	

DESCRIPTION	SPECIFICATION REQUIREMENT	To be filled up by the Bidder
. Power frequency withstand voltage :		
- across opening distance KV rms	460+145	
. Lighting impulse withstand voltage :		
- across opening distance KV peak	1050+206	
. Normal current at 45 C		
- Busbar A	3150	
- Bays A	3150	
. Number auxiliary contact		
- close position		
NO	-	
NC	-	
- open position		
NO	-	
NC	-	
. Motor voltage Vdc	220	
. Motor power W	-	
. Speed of opening operation	1m/s	
. Speed of closing operation	1m/s	
. Earthing switches		
. Maker name and country of manufacturer	-	
. Type	M2	
. Standards	IEC	
. Characteristics	Off-load break and fault make	
. Short circuit making current KA Peak	135	
. Continuous current A	N/A	
.Withstand earthing connection(kV)		
. Motor voltage Vdc	220	
. Motor power W	-	
. Speed of opening operation	1m/s	
. Speed of closing operation	1m/s	
. Number of auxiliary contacts		
- Close position		
NO	-	
NC	-	
- Open position		
NO	-	

DESCRIPTION	SPECIFICATION REQUIREMENT	To be filled up by the Bidder
NC	-	
. Surge Arrester		
Technical Data		
- System voltage(U_m)	220	
-Nominal frequency	50	
-Nominal voltage(U_r)	198	
-Temporary overvoltage(TOV)		
. 10 sec	218	
. 1 sec	228	
-Maximum continuous voltage (U_c)	168	
-Earth fault factor	/	
-Maximum residual voltage (8/20 μ s wave):		
. 5KA	560	
. 10KA	600	
. 20KA	-	
-Nominal discharge current(8/20 μ s wave) KAp	10	
-Energy discharge capability(2 shots without cooling)	15	
. Current transformers(Line Bays)		
. Core-1		
. Maker name and country of Manufacturer	-	
. Type	-	
. Standards	IEC	
. Rated primary current A	1200	
. Ratio of transformation	1200-600-300/1-1-1-1A	
. Rated burden VA	--	
. Accuracy class	PS	
. Minimum knee point voltage	1200V at 1200/1A	
. Exciting current at half minimum knee point voltage mA	30mA	
. Maximum secondary winding resistance at 75 C ohm	4 ohms at 1200/1A at 75°C	
. insulation material	SF ₆ gas	
. Current transformers		
. Core – 2		
. Maker name and country of Manufacturer.	-	

DESCRIPTION	SPECIFICATION REQUIREMENT	To be filled up by the Bidder
. Type	-	
. Standards	IEC	
. Rated primary current A	1200	
. Ratio of transformation	1200-600-300/1-1-1-1A	
. Rated burden VA	--	
. Accuracy class	PS	
. Minimum knee point voltage	1200V at 1200/1A	
. Exciting current at half minimum knee point voltage mA	30mA	
. Maximum secondary winding resistance at 75C ohm	4 ohms at 1200/1A at 75°C	
. insulation material	SF ₆ gas	
. Current transformers		
. Core -3		
. Maker name and country of Manufacturer	--	
. Type	--	
. Standards	IEC	
. Rated primary current A	1200	
. Ratio of transformation	1200-600-300/1-1-1-1A	
. Rated burden VA	20	
. Accuracy class	0.2S	
. Minimum knee point voltage	--	
. Exciting current at half minimum Knee point voltage mA.	--	
. Secondary winding resistance at 75C ohm	--	
. insulation material	SF ₆ gas	
. Core -4		
. Maker name and country of Manufacturer	--	
. Type	--	
. Standards	IEC	
. Rated primary current A	1200	
. Ratio of transformation	1200-600-300/1-1-1-1A	
. Rated burden VA	--	
. accuracy class	PS	
. Minimum knee point voltage	1200V at 1200/1A	
. Exciting current at half minimum knee point voltage mA	30mA	
. Maximum secondary winding	4 ohms at 1200/1A	

DESCRIPTION	SPECIFICATION REQUIREMENT	To be filled up by the Bidder
resistance at 75 C ohm		
. insulation material	SF ₆ gas	
. Core -5		
. Maker name and country of Manufacturer	--	
. Type		
. Standards	IEC	
. Rated primary current A	1200	
. Ratio of transformation	1200-600-300/1-1-1-1A	
. Rated burden VA	--	
. accuracy class	PS	
. Minimum knee point voltage	1200V at 1200/1A	
. Exciting current at half minimum knee point voltage mA	30mA	
. Maximum secondary winding resistance at 75 C ohm	4 ohms at 1200/1A	
. insulation material	SF ₆ gas	
. Current transformers (Trafo Bays)		
. Core-1		
. Maker name and country of Manufacturer	-	
. Type	-	
. Standards	IEC	
. Rated primary current A	240	
. Ratio of transformation	240-120-60/1-1-1-1A	
. Rated burden VA	--	
. Accuracy class	PS	
. Minimum knee point voltage	1200V at 240/1A	
. Exciting current at half minimum knee point voltage mA	30mA	
. Maximum secondary winding resistance at 75 C ohm	4 ohms at 240/1A at 75°C	
. insulation material	SF ₆ gas	
. Current transformers		
. Core – 2		
. Maker name and country of Manufacturer.	-	
. Type	-	
. Standards	IEC	
. Rated primary current A	240	
. Ratio of transformation	240-120-60/1-1-1-1A	

DESCRIPTION	SPECIFICATION REQUIREMENT	To be filled up by the Bidder
. Rated burden VA	--	
. Accuracy class	PS	
. Minimum knee point voltage	1200V at 240/1A	
. Exciting current at half minimum knee point voltage mA	30mA	
. Maximum secondary winding resistance at 75C ohm	4 ohms at 240/1A at 75°C	
. insulation material	SF ₆ gas	
. Current transformers		
. Core -3		
. Maker name and country of Manufacturer	--	
. Type	--	
. Standards	IEC	
. Rated primary current A	240	
. Ratio of transformation	240-120-60/1-1-1-1-1A	
. Rated burden VA	20	
. Accuracy class	0.2S	
. Minimum knee point voltage	--	
. Exciting current at half minimum knee point voltage mA.	--	
. Secondary winding resistance at 75C ohm	--	
. insulation material	SF ₆ gas	
. Core -4		
. Maker name and country of Manufacturer	--	
. Type	--	
. Standards	IEC	
. Rated primary current A	240	
. Ratio of transformation	240-120-60/1-1-1-1-1A	
. Rated burden VA	--	
. accuracy class	PS	
. Minimum knee point voltage	1200V at 240/1A	
. Exciting current at half minimum knee point voltage mA	30mA	
. Maximum secondary winding resistance at 75 C ohm	4 ohms at 240/1A	
. insulation material	SF ₆ gas	
. Core -5		
. Maker name and country of	--	

DESCRIPTION	SPECIFICATION REQUIREMENT	To be filled up by the Bidder
Manufacturer		
. Type	--	
. Standards	IEC	
. Rated primary current A	1200	
. Ratio of transformation	1200-600-300/1A	
. Rated burden VA	--	
. accuracy class	PS	
. Minimum knee point voltage	1200V at 1200/1A	
. Exciting current at half minimum knee point voltage mA	30mA	
. Maximum secondary winding resistance at 75 C ohm	4 ohms at 1200/1A	
. insulation material	SF ₆ gas	
. Current transformers (Bus coupler bay)		
. Core-1		
. Maker name and country of Manufacturer	--	
. Type	--	
. Standards	IEC	
. Rated primary current A	1200	
. Ratio of transformation	1200-600-300/1-1-1-1-1A	
. Rated burden VA	--	
. Accuracy class	PS	
. Minimum knee point voltage	1200V at 1200/1A	
. Exciting current at half minimum knee point voltage (mA)	30mA	
. Maximum secondary winding resistance at 75 C ohm	4 ohms at 1200/1A	
. insulation material	SF ₆ gas	
. Current transformers		
. Core – 2		
. Maker name and country of Manufacturer.	--	
. Type	--	
. Standards	IEC	
. Rated primary current A	1200	
. Ratio of transformation	1200-600-300/1-1-1-1-1A	
. Rated burden VA	20	
. Accuracy class	0.2S	
. Minimum knee point voltage	-	

DESCRIPTION	SPECIFICATION REQUIREMENT	To be filled up by the Bidder
. Exciting current at half minimum knee point voltage (mA)	-	
. Maximum secondary winding resistance at 75C ohm	-	
. insulation material	SF ₆ gas	
. Current transformers		
. Core -3		
. Maker name and country of Manufacturer	--	
. Type	--	
. Standards	IEC	
. Rated primary current A	1200	
. Ratio of transformation	1200-600-300/1-1-1-1-1A	
. Rated burden VA	--	
. Accuracy class	PS	
. Minimum knee point voltage	1200V at 1200/1A	
. Exciting current at half minimum knee point voltage (mA)	30mA	
. Secondary winding resistance 75C ohm	4 ohms at 1200/1A	
. insulation material	SF ₆ gas	
. Core -4	SPARE	
. Maker name and country of Manufacturer	--	
. Type	--	
. Standards	IEC	
. Rated primary current A	1200	
. Ratio of transformation	1200-600-300/1-1-1-1-1A	
. Rated burden VA	--	
. accuracy class	PS	
. Minimum knee point voltage	1200V at 1200/1A	
. Exciting current at half minimum knee point voltage (mA)	30mA	
. Maximum secondary winding resistance at 75 C ohm	4 ohms at 1200/1A	
. insulation material	SF ₆ gas	
. Core -5		
. Maker name and country of Manufacturer	--	
. Type	--	
. Standards	IEC	

DESCRIPTION	SPECIFICATION REQUIREMENT	To be filled up by the Bidder
. Rated primary current A	1200	
. Ratio of transformation	1200-600-300/1-1-1-1-1A	
. Rated burden VA	--	
. accuracy class	PS	
. Minimum knee point voltage	1200V at 1200/1A	
. Exciting current at half minimum knee point voltage (mA)	30mA	
. Maximum secondary winding resistance at 75 C ohm	4 ohms at 1200/1A	
. insulation material	SF ₆ gas	
. Voltage transformers (bus bars)		
. Maker name and country of Manufacturer	--	
. Type	--	
. Standards	IEC	
. Rated primary voltage KV	220/√3	
. Winding 1 :		
- Rated secondary voltage V	110/√3	
- Accuracy class	0.2	
- Rated burden VA	50	
. Winding 2 :		
- Rated secondary voltage V	110/√3	
- Accuracy class	3P	
- Rated burden VA	50	
. Winding 3 :		
- Rated secondary voltage V	110/√3	
- Accuracy class	3P	
- Rated burden VA	50	
. insulation materials	SF ₆ gas	
. Rated voltage factor		
- continuous	1.2	
- for 30 seconds	1.5	
. Whether VTs are capable of sustaining capacitive discharge current of a de-energized cable feeder.	Yes	
. Ratio error		
- for metering cores	±0.2%	
- for protection cores	±3%	
- phase displacement error	±10 minutes(0.2) ±20minutes(3P)	

DESCRIPTION	SPECIFICATION REQUIREMENT	To be filled up by the Bidder
. Power frequency withstand voltage of secondary voltage	3kV(1min)	
. Voltage transformers (Line bays)		
. Maker name and country of Manufacturer	--	
. Type	--	
. Rated primary voltage KV	220/√3	
. Winding 1 :		
- Rated secondary voltage V	110/√3	
- Accuracy class	0.2	
- Rated burden VA	50	
. Winding 2 :		
- Rated secondary voltage V	110/√3	
- Accuracy class	3P	
- Rated burden VA	50	
. Winding 3 :		
- Rated secondary voltage V	110/√3	
- Accuracy class	3P	
- Rated burden VA	50	
. insulation materials	SF ₆ gas	
. Rated voltage factor		
- continuous	1.2	
- for 30 seconds	1.5	
. Whether VTs are capable of sustaining capacitive discharge current of a de-energized cable feeder	Yes	
. Ratio error		
- for metering cores	±0.2%	
- for protection cores	±3%	
- phase displacement error	±10 minutes(0.2) ±20minutes(3P)	
. Power frequency withstand voltage of secondary voltage	3kV(1min)	
. Local Control cubicle :		
. Dimension	--	
. Thickness of sheet used	--	
. Cross sectional area of conductor for control wiring (CT, PT other circuits)	CT/PT:4mm ² Others:≥1.5mm ²	
. Dimension	-	
- Width*Breadth*height	-	

Part 2.1
GIS VENTILATION SYSTEM

TECHNICAL SPECIFICATION FOR GIS VENTILATION SYSTEM

INTRODUCTION:

This Specification is intended to establish design criteria for ventilation system of the following infrastructure facilities required for 220/33kV Switching substation, ODISHA at TFL Premises.

- 220kV GIS BUILDING.

This specification will also present general operational requirement, description of the ventilation system envisaged.

Ventilation system:

220kV GIS hall shall have an independent ventilation system. Each ventilation system shall consist of two 100% capacity systems, one operating and one stand-by.

To ensure that the air being supplied to the GIS hall is free from dust particles, a minimum two stage dust filtration process shall be supplied. This shall consist of at least the following:

1. Pre Filters:

To remove dust particles down to 10 micron in size with at least 95% efficiency

2. Fine Filters:

To remove dust particles down to 5 microns in size with at least 99% efficiency

- All the filters shall be panel type. Easy access should be available to the filters for replacement/cleaning.
- The ventilation of the 220kV GIS hall shall be of a positive pressure type with minimum 4 air changes per hour.
- The pressure inside the 220kV GIS hall shall be maintained 5mm of Water above the atmospheric pressure.
- Fresh outdoor air shall be filtered before being blown into the GIS hall by the air fans to avoid dust accumulation on components present in the GIS hall.
- 220kV GIS hall shall be provided with motorized exhaust dampers with local control.

GENERAL OPERATIONAL REQUIREMENTS:

The primary requirement of the ventilation system is to provide acceptable environmental conditions suitable for all occupied areas and for all electrical panels & equipment requiring a regulated environment. The conditions air infiltration, air movement shall be controlled as required in the respective areas

The ventilation system performs the following objectives:

- Maintain proper air circulation inside room
- Maintain dust free environment through pressurized system

– Removal of bad odor, vapor generated inside room

The concept as presented here below for various facilities follows the above general operational requirements and is based on the requirement of the specification as well as on the applicable local and international codes and standards.

APPLICABLE CODES & STANDARDS:

- ASHRAE handbook
- Occupational safety and health act (USA)
- ISHRAE publications
- IS 277 - Galvanized steel sheets
- IS 325 - Three phase induction motors

The list furnished above for Codes & standards may not cover certain aspects or products. In such cases where norms/ standards/ guidelines other than those listed above are followed, approval from owner’s engineers will be solicited.

SYSTEM DESCRIPTION:

VENTILATION SYSTEM:

Following are the systems to be adopted for Ventilation arrangement and ventilation fan sizing.

PREMISES TO BE COVERED	TYPE OF VENTILATION SYSTEM
TFL S/S- 220kV GIS BUILDING	Filtered air supply by floor mounted Centrifugal fan filter Unit of 2 nos. (1W+1S) and hot air exhaust through wall mounted Motorized Exhaust Damper. Fan filter unit shall be installed in AHU room.

SYSTEM COMPONENT FOR VENTILATION SYSTEM:

Pressurized Ventilation System shall be provided for TFL S/S- 220kV GIS BUILDING S/S with floor mounted Centrifugal type Supply Air Fan, inlet louver, dry panel type pre- filter (95% efficiency down to 10 micron), fine filter (99% efficiency down to 5 micron), flexible connection, duct work, supply air grille with VCD etc. as required and exhaust through wall mounted Motorized Exhaust Damper.

CONTROL SYSTEM:

All ventilation fan, motorized dampers shall be operated through MCC cum PDB. Fans in case of fire in the respective zone shall be stopped through the MCC cum PDB in the event of receive of fire signal form a particular zone.

Motors of exhaust dampers provided in Wall remain de-energized in normal condition to effect close of dampers. In the event of Over Pressure, the motors of Exhaust dampers will be energized and the damper will be opened due to spring action, the relevant DP Switch can get the Feedback for Exhaust Damper.

DESIGN CRITERIA:

OUTSIDE DESIGN CONDITIONS:

Summer: 35°C Dry Bulb and 66% RH

Monsoon: 28.7°C Dry Bulb and 86% RH

Winter: 11.2°C Dry Bulb and 73% RH

AIR CHANGE PER HOUR (ACPH) FOR VENTILATION SYSTEM:

Following Air Change per Hour shall be followed for various buildings, as per the Industrial standard generally followed for selecting fan capacity.

S.NO.	NAME OF THE AREA	MINIMUM AIR CHANGE RATE PER HOUR (ACPH)
1.	220kV GIS Hall	2

PART-3
220/33kV, 20MVA POWER TRANSFORMER

TECHNICAL SPECIFICATION

Sl. No: Title:

- 1.0** SCOPE.
- 2.0** Standards
- 3.0** Auxiliary Power Supply.
- 4.0** Principal Parameters.
- 5.0** General Technical Requirements.
- 5.1** Duty requirements.
- 5.2** Transformer Losses
- 5.3** Constructional Details.
- 5.3.1** Tank and Tank Accessories.
- 5.3.2** Valves and Location.
- 5.3.3** Joints and Gaskets.
- 5.3.4** Pressure relief device.
- 5.3.5** Ear thing terminals.
- 5.3.6** Corrosion Protection.
- 5.3.7** Rating, diagram and valve plates.
- 5.3.8** Core.
- 5.3.9** Windings.
- 5.3.10** Gas and Oil actuated relays.
- 5.3.11** Temperature indicating devices and alarms.
- 5.3.12** Cooling equipment and its control.
- 5.3.13** Voltage selection and control.
- 5.3.14** Supervisory control.
- 5.3.15** Terminal and connection arrangements.
- 5.3.16** Specification for control cabinets.
- 5.3.17** Insulating Oil.
- 5.3.18** Cleaning, painting and tropicalization.
- 5.3.19** Bolts and Nuts.
- 5.3.20** Wiring and cabling.
- 5.3.21** Fittings.
- 5.3.22** Limits of Temperature rise.
- 5.3.23** Motors & MCBs.
- 5.3.24** List of Mandatory Spares.
- 5.3.25** Nitrogen injection fire protection system
- 6.0** Inspection and Testing.
- 6.1** Testing facilities
- 6.2** General
- 6.3** Stage Inspection.
- 6.4** Final Inspection
- 6.4.1** Type Tests & Special Tests
- 6.4.2** Routine Tests
- 6.4.3** Tests on site
- 7.0** Test Reports.
- 8.0** List Of Transformer Accessories
And Test Certificates required for them.

- 9.0** Inspection.
- 9.1** General.
- 9.2** Inspection Programme.
- 9.3** Pre-shipment check at supplier's works.
- 9.4** Recommended commissioning checks.
- 10.0** Quality assurance plan.
- 11.0** Documentation.
- 12.0** Packing and forwarding.
- 13.0** Supervision of erection, testing and commissioning.
- 14.0** Quantity and delivery requirements.
- 15.0** Values quoted in G.T.P and loss calculation.

ANNEXURES

No. Title.

- I.**Quantity and Delivery Schedule.
- II.**Maximum Flux Density and Core weight calculation.
- III.**Details of Loss Calculations.
- IV.**Guaranteed Technical Particulars.
- V.**Additional Schedule of Information.
- VI.**Check list towards Type Test Reports.
- VII.**Calibration Status of Testing Instruments/Meters.
- VIII.**Check list for Delivery Schedule.

N. B.:

- 1. Annexure-I to VIII are to be filled up in complete shape by the bidders, failing which their tenders are liable for rejection.**

- 2. No approximate value is allowed in respect of any of the asked parameter in the Annexure. The bidders may quote the firm values with tolerances, if asked in respective parameters.**

TECHNICAL SPECIFICATION OF 20MVA POWER TRANSFORMER

1.0 SCOPE:

- 1.1 This Specification provides for design, manufacture, inspection and testing before despatch, packing and delivery at destination Sub-station by road transport, unloading on plinth at site (if the plinth is not ready at the time of unloading, then the transformer shall be unloaded at the nearest accessible point to plinth) and supervision of erection, testing and commissioning of Power Transformer, complete with all fittings, accessories, associated equipment and spares, required for its satisfactory operation.
- 1.2 The transformers shall conform in all respects to high standards of engineering, design, workmanship and the latest revisions of relevant standards at the time of offer and Owner shall have the power to reject any work or material which, in his judgment, is not in full accordance therewith. The transformer(s), offered shall be complete with all components, necessary for their effective and trouble free operation. Such components shall be deemed to be within the scope of supply, irrespective of whether those are specifically brought out in this Specification and/or the commercial order or not. Transformer shall be supplied with Nitrogen Injection Fire Prevention system. All necessary provisions, valves etc., shall be in the scope of transformer supplier.
- 1.3 The transformer(s), to be supplied against this specification shall be suitable for satisfactory continuous operation under the following Topographical and Meteorological conditions:-

a)	Maximum ambient air temperature (°C)	55
b)	Minimum ambient air temperature (°C)	5
c)	Average daily ambient air temperature (°C)	32
d)	Relative humidity (%)	100
e)	Average rainfall per annum (cm)	150
f)	Maximum altitude above mean Sea level (m)	1000
g)	Maximum wind pressure (Kg/m ²)	80.84
h)	Isoceraunic level (days/year)	70
i)	Seismic withstand factor(g)	0.3
j)	Wind Velocity-(Wind Zone to IS875) (m/sec)	50
k)	Pollution level to IEC815	VERY HEAVY

2.0 STANDARDS:

- 2.1 All transformers and associated equipments and accessories shall, except where modified by this Specification, be designed, manufactured and tested in accordance with the latest editions of the relevant International (IEC), Indian (IS) and British (BS) standards. In case of conflict, the order of precedence shall be (1) IEC, (2) IS, (3) Others.

Reference to particular standard or recommendation in this Specification does not relieve the Supplier of the necessity of providing goods and services, complying with other relevant standards or recommendations.

The list of standards, provided in this Specification is not to be considered exhaustive and the supplier shall ensure that equipments, supplied under this contract meet the requirements of the relevant standard whether or not it is mentioned here.

IEC	IS	BS/other	Title
60076 P-1-2000 P-2-1993	2026	171	141 Power Transformers

IEC	IS	BS/other	Title
617	-	-	Graphical Symbols for drawings
	2629	729	Galvanising
-	2633	-	Methods of testing uniformity for zinc coated articles
-	5	-	Colours for ready mixed paints and enamels
-	2147	-	Degrees of protection provided by enclosures for voltage switchgears and control gears
-	3401/1992	-	Silica gel
-	9434	-	Guide for sampling and analysis of dissolved gas in oil filled equipment
-	12676	-	Oil impregnated paper insulated Bushing dimension and requirements.
60071, P-1-1993 P-2-1996	-	-	Insulation Co-ordination
-	375	-	Markings & Arrangements for switchgear Bus bars, Main connections and Auxiliary wiring
-	3638/1996	-	Application Guide for Gas operated Relays.
60214(1989)	8468	-	On-load Tap-changer.
-	8269	-	Methods for switching Impulse Test on high voltage insulators
-	10028/1981 (part-2)	-	Installation of Transformers
-	10028/1981 (part-2)	-	Maintenance of Transformers.
-	10561/1983	-	Application Guide of Power Transformers.
60542, Amd 1-1988	8468/1997	-	Application Guide for On-load Tap-changer.
-	8263	-	Method for Radio Interference Tests on High Voltage Insulators.
-	3202	-	Code of practice for climate proofing of Electrical Equipment
-	6702/1972	-	Method of determination of Electric strength of insulating oils
-	6103/1971	-	Method of Test for specific Resistance of Elect. Insulating Liquids.
-	6262/1971	-	Method of Test for power factor and Dielectric Constant of Electrical Insulating Liquids.

IEC	IS	BS/other	Title
-	6104/1971	-	Method of Test for Interfacial Tension of oil against water by the Ring Method.
60034, P1-22(1972-2000)	-	-	Rotating Electrical Machines.
60044, AmdP1-2006, P-6-1992	-	-	Instrument Transformers
60060, P-1-1989, Amd P-2-1996	-	-	High Voltage Test Techniques
60085 (1994)	-	-	Thermal Evaluation and classification of Elect. insulation
60270 (1981)	-	-	Partial Discharge Measurements.
60404-8-7 (1998)	-	-	Specification for Individual Materials-Cold Rolled Grain oriented Electrical Steel sheet and strip delivered in fully processed state
60529 (Amd 1-1999)	-	-	Degree of protection, provided by enclosures (IP-Code)
60551(Amd 1-1995)	-	-	Determination of Transformer and Reactor sound levels.
60567(1992)	-	-	Guide for sampling Gases and oil from oil-filled Electrical equipment for the analysis of free and dissolved gases
60599(1999)	-	-	Mineral Oil-Impregnated Electrical Equipment in service-Guide to the Interpretation of Dissolved and Free Gases Analysis.
60722 (1982)	-	-	Guide to the Lightning and Switching Impulse testing of power transformers and reactors
60815 (1986)	-	-	Guide for selection of Insulators in respect of polluted conditions.
60947, P-1-7 (1984-2000)	-	-	Low voltage switchgear & control gear.
-	-	IEEE C 57.93 , IEEE 1995	Guides for Installation of Liquid Immersed power transformers
-	-	IEEE Std 80	Guide for safety and AC Sub-station grounding
-	-	IEEE Std 979	Guide for Sub-station Fire protection.

-	-	IEEE Std 980	Guide for containment and control of oil spills in substation
-	-	CBIPPub.29 5/2006	Manual on Transformers.
-	-	NFPA NEMA-Standard No.1. Indian Electricity Rules-1956.	National Fire Protection Association.

2.2 The standards, mentioned above are available from:

Standard:	Name and address:
IS	Bureau of Indian Standards, Manak Bhawan, 9-Bahadur Sahah Zafar Marg, New Delhi - 110001, India
IEC	International Electro Technical Commission, Bureau Central dela Commission, Electro Technique International, 1-Ruede Verembe, Geneva, SWITZERLAND.

2.3 Transformer meeting with requirements of other authoritative International Standards that ensure equal or better performance than the standards, mentioned above shall also be considered. When the transformer, offered by the supplier conforms to other standards, salient points of difference between standards adopted and the standards, specified in this specification shall be clearly brought out in the offer. Two copies of such standards with authentic translation in English shall be furnished along with the offer.

3.0 AUXILIARY POWER SUPPLY:-

Auxiliary electrical equipment shall be suitable for operation on the following supply system.

- a) Power devices like drive motors of Rating 1KW and above. 415V, 3Phase, 4 Wire, 50 Hz, neutral Grounded AC supply.
- b) Lighting, space heaters and KW Motors. 240V, single phase, 50Hz, neutral Grounded AC supply.
- c) Alarm control and protective Devices. 220V, DC, 2 Wire.

Each of the foregoing supplies shall be made available by the owner at the terminal point for each transformer for operation of accessories and auxiliary equipment. Supplier's scope includes supply of interconnecting cables, terminal boxes etc. The above supply voltage may vary as below and all devices shall be suitable for continuous operation over entire range of voltages.

- (i) AC Supply: Voltage $\pm 10\%$
Frequency $\pm 5\%$
- (ii) DC Supply: - 15% to + 10%

4.0 PRINCIPAL PARAMETERS:-

20MVA, 220/33KV Power Transformer

The transformer shall conform to the following specific parameters:-

Sl. No.	Item.	Specification.
1)	Type of Power Transformer/Installation.	3 Phase Core types, 2 winding transformer, suitable for outdoor installation and suitable for bi-directional flow of power.
2)	Type of Mounting.	On wheels, mounted on rails
3)	Suitable for rated system frequency.	50 Hz ($\pm 5\%$).
4)	Maximum system voltage ratio (HV/LV).) Nominal voltage ratio (HV/LV).	245 KV/36KV 220 KV/33KV
5)	No. of Phases.	3 (Three)
6)	No. of Windings.	Two winding Transformer
7)	Type of Cooling.	ONAN/ONAF
8)	MVA Rating corresponding to cooling system. (a) ONAN cooling (b) ONAF cooling	20MVA 80% - 16MVA 100% - 20 MVA
9)	Method of connection.	HV – Star LV – Star
10)	Connection symbol.	YNyno
11)	System Earthing	Effectively solidly earthed (Neutral of both H.V & L.V)

Sl. No.	Item.	Specification.
12)	Percentage Impedances on normal tap and MVA base corresponding to HV/LV rating and applicable tolerances: NOTE: - No reactor either inside or outside the tank shall be used to achieve above % Imp. Value.	% Impedance with Tolerance 12.5%+10 % (Tol.) (No negative tolerance is allowed)
13)	Intended regular cyclic overloading of windings.	As per IEC76 -1, Clause 4.2
14)	Anticipated unbalanced loading. Anticipated Continuous loading of windings(H.V and L.V)	< 10% 110% of rated current
15)	Tap changing gear: - (i) Type. (ii) Provided on. (iii) Tap range. (iv) Tap step. (v) Automatic control required? (vi) Remote control panel required? (vii) DC supply. (viii) Supervisory control provision required? (ix) Marshalling Kiosk required? (x) No. of Transformers in parallel for which auto control to be suitable (xi) Current rating of OLTC (xii) Short circuit current rating of OLTC	In Tank, Hi-speed Resistor Type On load. H.V. side - 10% to +10%. 1.25% of 220KV Yes. Yes. As per Specification. Yes. Yes. 2 (Maximum). 350A(Min.) 6KA(Min.)
16)	Over voltage operating capability and duration.	125% rated voltage for 60 seconds 140% rated voltage for 5 seconds. 110% rated voltage continuous
17)	Minimum Air core reactance of HV windings	20%
18)	Minimum knee point voltage (This will be determined during no load test method that 10% increase in voltage from 110% rated voltage causes the excitation current to increase not by more than 50%).	At 110% of rated voltage.
19)	Maximum Flux Density in any	1.6 Tesla

	part of the core and yoke at rated MVA, Maximum System voltage [245 KV/36 KV] and minimum system frequency [48.5 HZ] [In Tesla].									
20)	Insulation levels:- For windings:- (a) 1.2/50 microsecond wave Shape Impulse Withstand (KVP). (b) Power frequency voltages withstand (KV- rms). (c) Separate source withstand voltage(KV-rms)	<table border="0"> <tr> <td>HV</td> <td>LV</td> </tr> <tr> <td>950</td> <td>170</td> </tr> <tr> <td>395</td> <td>70</td> </tr> <tr> <td>38</td> <td>70</td> </tr> </table>	HV	LV	950	170	395	70	38	70
HV	LV									
950	170									
395	70									
38	70									
21)	Type of winding insulation:- (a) HV (b) LV winding.	Graded. Full.								
22)	Short Circuit Withstand Capability:- a) Withstand time for three phase short circuit at Terminals. b) System short circuit level for which the transformer shall be capable to withstand	5 seconds. 50.0kA(rms) -220KV 31.5kA(rms)-33KV								
23)	Partial discharge	As per relevant up-to-date IEC								
24)	Noise level at rated voltage and frequency.	As per latest NEMA Std. Tr-1.								
25)	Permissible Temperature Rise over ambient temperature of 50° C. i. Of top oil measured by thermometer. ii. Of winding measured by resistance. iii. Reference ambient temperature	45° C 50° C 50° C [MAX.]								
26)	Minimum clearances in air (mm):- a) HV b) LV c) HV to LV	<table border="0"> <tr> <td>Phase to phase.</td> <td>Phase to ground</td> </tr> <tr> <td>2350</td> <td>2150</td> </tr> <tr> <td>400</td> <td>320</td> </tr> <tr> <td>2200</td> <td></td> </tr> </table>	Phase to phase.	Phase to ground	2350	2150	400	320	2200	
Phase to phase.	Phase to ground									
2350	2150									
400	320									
2200										
27)	Terminals: (a) HV winding line end. (b) LV Winding & Neutrals (c) HV Neutral	245kV RIP condenser bushing 36KV oil -filled porcelain communicating type bushing (Anti-fog type) 52kV RIP Condenser bushing								
28)	Bushing current rating.	1. 245 KV - 1250 Amp. 2. 36 KV - 1000 Amp.								

		3. 52 KV(N) - 1000 Amp 4. 36 KV (N) - 1000 Amp.																									
29)	Maximum Radio Interference Voltage level at 1MHZ & 1.1 times max. rms phase to ground Voltage for HV winding	500 micro volts.																									
30)	Minimum visual corona extinction voltage	As per ISS/IEC																									
31)	COOLER BANK a) Number of cooler banks required per Transformer. b) Rating of each bank as % of total loss. c) No. Of fans	Minimum of two. Not greater than 50%. Adequate no. Of fans of 18"/24" sweep with one No. stand-by fan in each bank.																									
32)	Insulation level of bushing a) Lightning Impulse withstand (KVP) b) 1 Minute Power Frequency withstand voltage(kV-rms) c) Creepage distance (mm). (min.) d) Maximum Tan Delta for bushings at ambient Temp. (Tan delta shall be measured at ambient temperature. No temperature correction factor shall be applied)	<table border="1"> <thead> <tr> <th></th> <th>HV</th> <th>LV</th> <th>LVN</th> <th>HVN</th> </tr> </thead> <tbody> <tr> <td>a)</td> <td>1050</td> <td>170</td> <td>170</td> <td>250</td> </tr> <tr> <td>b)</td> <td>460</td> <td>70</td> <td>70</td> <td>95</td> </tr> <tr> <td>c)</td> <td>7595</td> <td>1116</td> <td>1116</td> <td>1612</td> </tr> <tr> <td>d)</td> <td colspan="4" style="text-align: center;">< 0.004</td> </tr> </tbody> </table>		HV	LV	LVN	HVN	a)	1050	170	170	250	b)	460	70	70	95	c)	7595	1116	1116	1612	d)	< 0.004			
	HV	LV	LVN	HVN																							
a)	1050	170	170	250																							
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c)	7595	1116	1116	1612																							
d)	< 0.004																										
33)	Material of HV & LV Conductor.	COPPER																									
34)	Neutral Bushing C.T.: (i) Type. (ii) Quantity. (iii) Voltage class. (iv) No. of cores. (v) Current ratio (A/A). (vi) Turn ratio. (vii) Knee point voltage. (viii) Class of Accuracy. (ix) Maximum secondary winding resistance(ohms) (x) Maximum Excitation current at minimum Knee Point Voltage at $V_k/2$ (xi) Location for Mounting (xii) Secondary current rating	<p>Single Phase, ring type Turret Mounted Two(one in H.V side & one in L.V side) 36kV. One For HV NCT-120-60/1A For LV NCT- 800-400-200/1A Identical to turns ratio, provided on HV and LV side Phase bushing CTs.</p> <p>600 volts P.S. 5 at 75°C.</p> <p>25 mA</p> <p>Bracket mounted on tank (with neutral lead for connection for Neutral Bushing to NCT) 1 Amp</p>																									

35)	a) Maximum current density for HV & LV windings for rated current. b) Maximum Tan Delta for winding at ambient Temp. (Tan delta shall be measured at ambient temperature. No temperature correction factor shall be applied)	2.8 A/ mm ² < 0.005
36)	Type of oil preservation.	Air cell type.
37)	(i) Minimum Insulation resistance at an ambient Temperature of 30 deg. C with 5KV Megger for 600 seconds duration. (ii)Polarisation index i.e. ratio of IR values at 600 sec. to 60 sec. for H.V. to Earth, L.V. to Earth and H.V to L.V	HV /E & LV/E-3000 M-ohms HV /LV -4000 M-ohms Shall be greater than or equal to 2, as per Cl.No-7.2.13.4 IEEE Standard C57.152-2013
38)	Zero Sequence Impedance	Shall be 80% or more of the positive sequence value.
39)	Core Assembly	BOLTLESS TYPE
40)	No of pressure relieve device to be provided	TWO

5.0 GENERAL TECHNICAL REQUIREMENTS:

5.1 Duty Requirements:

The transformer will be used for bi-directional flow of rated power.

The transformer and all its accessories like C.Ts. shall be designed to withstand the thermal and mechanical effects of a short circuit at the terminals of any winding with full voltage, maintained on all other windings for duration of three seconds. The successful Agency has to furnish the supporting calculations for the above requirements. The short circuit level of the H.V. system to which the subject Transformer will be connected is 50KA (rms, 3-phase fault) for 220KV and 31.5KA for 33KV system. The transformer shall be capable of being loaded in accordance with IS: 6600 up to loads of 150 %. There shall be no limitation imposed by bushings, tap changer etc.

The transformer shall be capable of being operated without danger on any tapping at the rated KVA with voltage variation of $\pm 10\%$ corresponding to the voltage of that tapping.

Radio interference and Noise level:

- (i) The transformers shall be designed with particular attention to suppression of maximum harmonic voltage, especially the third and fifth so as to minimize interference with communication circuits.
- (ii) The noise level, when energized at normal voltage and frequency with fans running shall not exceed, when measured under standard conditions, the values, specified in NEMA, TR-1.

The transformer noise levels shall be measured as a routine test and in accordance with IEC-60551:1981.

Transformer shall be capable of operating under the natural cooled condition up to the specified load. The forced cooling equipment shall come into operation by preset contacts of winding temperature indicator and the transformer shall operate as a forced cooled unit, as ONAF up to specified load. Cooling shall be so designed that during total failure of power supply to cooling fans, the transformer shall be able to operate at full load for at least ten (10) minutes without the calculated winding hot

spot temperature exceeding 150 degree centigrade. Also stopping of one or two cooling fans should not have any effect on the cooling system. Transformers fitted with two coolers each capable of dissipating 50 percent of the loss at continuous maximum rating shall be capable of operating for 20 minutes in the event of failure of the blowers, associated with one cooler, without the calculated winding hot spot temperature exceeding 115 degree centigrade at continuous maximum rating.

Transformer shall be capable of withstanding thermal and mechanical stresses, caused by symmetrical or asymmetrical faults on any winding.

Transformer shall accept, without injurious heating, combined voltage and frequency fluctuation, which produces the following over fluxing condition:

- (i) 125% for 1 minute The base voltage and frequency refer
140% for 5 seconds to those mentioned in Clause 4.0 (3& 4)
- (ii) Over fluxing withstand characteristics up to 170% shall be submitted along with the bid.

5.2 TRANSFORMER LOSSES:-

The bidder shall indicate values of No load losses (iron losses), load losses (copper losses) and auxiliary losses in his bid, which shall be firm.

Loss figure for evaluation of bid:-

~~For total cost evaluation for comparison, capitalized cost of losses shall be calculated at the following rates per one kilo watt of loss:~~

(i) No load losses	Rs. 3,08,438.00/KW
(ii) Load (Copper) losses	Rs. 1,85,063.00/KW
(iii) Auxiliary losses	Rs. 1,85,063.00/KW

~~For fraction of a KW, capitalized cost of losses should be calculated on pro-rata basis.~~

~~The lowest figure of loss for the transformer, quoted by any Bidder shall be taken as basis and that quoted by the particular Bidder shall be used to arrive at the differential bid price to be applied for the bid. The transformer losses, guaranteed in the bid are to be supported by design calculations along with documentary evidences.~~

The Maximum permissible losses for the above transformer should not exceed as per OPTCL Requirement:

- (i) No load losses at rated voltage and rated frequency: **12kW**
- (ii) Load loss at rated output, rated frequency, & at & 75 Deg C : **64kW**
- (iii) Auxiliary loss at rated output, rated frequency & at ambient temp: **01kW**

Liquidated damage for excessive losses:-

On Factory testing, if it is found that actual losses are more than the values, quoted in the bid, undisputed liquidated damages shall be recovered from the supplier at the following rates:-

- (i) For each KW of excess in 'No Load Losses' **Rs.6,16,876.00/KW**
- (ii) For each KW of excess in 'Load Losses' **Rs.3,70,126.00/KW**

And 'auxiliary losses'

For fractional of Kilowatt, penalties shall be applied on pro rata basis. No bonus shall be payable for losses, which are less than those, stated in the Bid.

The owner reserves the right to reject the transformer, if on testing, the losses exceed the declared losses beyond tolerance limits as per I.S. or the temperature rise in oil and/or winding exceed the values, specified in technical particulars or impedance value differs from the guaranteed value including tolerance as per this specification and if any of the test results do not match with the values, given in the guaranteed technical particulars and as per technical specification. The owner reserves the right to retain the rejected transformer and take it into service until the supplier replaces it, at no extra cost to the owner by a new transformer.

Clearance:

The overall dimensions of the transformer shall allow for sufficient clearances for installation in a 245/145 KV switchyard with bay width of 18000/10500 mm and boom height of 15/11 m.

5.3 CONSTRUCTIONAL DETAILS:

The features and constructional details of power transformer shall be in accordance with the requirements, stated hereunder:-

5.3.1 TANK AND TANK ACCESSORIES:-

TANK: -

- a) The transformer shall be enclosed in a suitably stiffened welded steel tank such that the transformer can be lifted and transported without permanent deformation or oil leakage. The construction shall employ weldable, low carbon, tested quality structural steel of an approved grade to BS: 4360. The transformer tank shall have rectangular shape. The minimum thickness of base and tank cover shall be 12mm. and that of sides is 8mm.
- b) The tank of the transformer shall be complete with all accessories and shall be designed so as to allow complete transformer in the tank and filled with oil, to be lifted by crane or jacks, transported by road or rail without over-straining any joint and without causing subsequent leakage of oil.
- c) All seams and those joints, not required to be opened at site shall be factory -welded and wherever possible they shall be double welded. After completion of tank construction and before painting, dye penetration test shall be carried out on welded parts of jacking bosses, lifting lugs and all load bearing members. The requirement of post-weld heat treatment for tank/stress relieving parts shall be based on recommendations of BS: 5500, Table 4.4.3.1.
- d) All necessary precautions shall be taken to prevent ingress of moisture between flange plates, around gaskets and O-rings, at insulator/flange interfaces etc. due to high humidity.
- e) Tank stiffeners shall be provided, if required, for general rigidity and these shall be designed to prevent retention of water.
- f) The transformer tank shall be of conventional type construction. In case the joint is welded, it shall be provided with flanges, suitable for repeated welding. The joint shall be provided with a suitable gasket to prevent weld splatter inside the tank. Proper tank shielding shall be done to prevent excessive temperature rise of the joint.
- g) The main tank body excluding tap-changing compartments, radiators and coolers shall be capable of withstanding vacuums i.e. 100.64 KN/m² of gauge pressure, 760 mm of Hg.
- h) The tank shall be designed to withstand:-
 - Mechanical shocks during transportation.
 - Vacuum filling of oil.
 - Continuous internal pressure of 35 KN/m² over normal Hydrostatic pressure of oil. Short circuit forces.
 - **Short circuit forces**
- i) Wherever possible, the transformer tank and its accessories shall be designed without pockets wherein gas may collect. Where pockets cannot be avoided, pipes shall be provided to vent the gas into the main expansion pipe. The vent pipes shall have minimum inside diameter of 15 mm except for short branch pipes, which may be 6 mm minimum inside diameter.
- j) All joints other than those, which may have to be broken, shall be welded, when required, they shall be double-welded. All bolted joints to the tank shall be fitted with suitable oil-tight gaskets, which shall give a satisfactory service under the operating conditions and guaranteed temperature-rise conditions. Special attention shall be given to the methods of making hot oil tight joints between the tank and the cover as also between the cover and the bushing and all other outlets to ensure that the joints can be remade satisfactorily at site and with ease with the help of semi -skilled labour. If gasket is compressible, metallic stops shall be provided to prevent

over compression.

- k) Adequate space shall be provided at the bottom of the tank for collection of sediments.
- l) The base of each tank shall be so designed that it shall be possible to move the complete unit by skidding in any direction without injury when using plates or rails.
- m) Tank shields shall be such that no magnetic fields shall exist outside the tank. They shall be of magnetically permeable material. If required, impermeable shields shall be provided at the coil ends. Tank shield shall not resonate when excited at the natural frequency of the equipment. Successful Agency may confirm use of tank shields in the schedule of additional information.
- n) Suitable guides shall be provided in the tank for positioning the core and coil assembly.
- o) The tank shall be designed such that it can be mounted on the plinth directly.
- p) When the transformers are provided with separately mounted radiators, flexible joints shall be provided in the main oil pipes, connecting the transformer tank to the radiator banks to reduce vibration and facilitate erection and dismantling.
- q) The transformer tank, fittings, radiators and all accessories shall be designed to withstand seismic acceleration, as specified.
- r) All connections, bolted to the tank shall be fitted with suitable gas oil resistant gaskets, made of such a material that no serious deterioration occurs under service conditions. Gaskets of nitrile rubber or equivalent shall be used to ensure perfect oil tightness. All gaskets shall be of closed design (without open ends) and shall be of one piece only. Rubber gaskets, used for flange connections of the various oil compartments shall be laid in grooves or in groove-equivalent retainers on both sides of the gaskets throughout their total length. Care shall be taken to secure uniformly distributed mechanical pressure over the gaskets and retainers throughout the total length. Gaskets of neoprene and/or any kind of impregnated/ bonded cork or cork only which can easily be damaged by over-pressing is not acceptable. Use of hemp as gasket material is also not acceptable.

LIFTING AND HAULAGE FACILITIES:-

The transformer tank shall be provided with: -

- a) Lifting lugs, suitable for the weight of the transformer, including core and windings, fittings and with the tank, filled with oil.
- b) At least four jacking lugs and where required, with lugs suitably positioned for transport on a beam transporter.
- c) Haulage lugs to enable a steel rope to be used safely for haulage in any direction.
- d) The transformer must be provided with clearly marked locations for the fixing of jacks.

The free space between the bottom of the tank and the fixing of jacks must be 300 - 350 mm.

FOUNDATIONS, CABLE DUCTING ETC.:-

The Supplier will have to liaise with the Purchaser or its authorised contractor immediately after Design approval to finalize the detailed design of the following:-

- Transformer main tank foundations.
- Cooler bank foundations.
- Marshalling kiosk/control cabinet location and foundation.
- Cable ducting requirements.
- Adequate bunding design for the complete containment of all oil spills.
- Any other civil/electrical requirements for the installation of the

TANK COVER:

- a) The tank cover shall be of adequate strength, shall not distort when lifted and shall be provided with suitable flanges having sufficient and properly spaced bolts. At least two adequately sized inspection openings, one at each end of the tank shall be provided for easy access to the internal

connections of bushings, winding connections and earthing links. The inspection covers shall not weigh more than 25 Kg. The inspection cover shall be provided with lifting handles.

- b) The tank and cover shall be designed in such a manner so as to leave no external pockets in which water can lodge, no internal pockets in which oil can remain when draining the tank or in which air can be trapped when filling the tank, and to provide easy access to all external surfaces for painting. The design of the tank cover should not present a safety hazard to personnel working on top of the unit.
- c) It must be possible to remove any bushing without removing the tank cover.
- d) One pocket shall be provided for stem type thermometer in addition to those for the Bulbs of the oil temperature and winding temperature indicators. These pockets shall be located in the position of the maximum oil temperature and it must be possible to remove any bulb without lowering the oil level in the tank. Captive screwed caps shall be provided to prevent the ingress of water to the thermometer pockets when they are not in use.
- e) Bushings, turrets, covers of inspection opening, thermometer pockets etc. shall be designed to prevent ingress of water into or leakage of oil from the tank.
- f) All bolted connections shall be fitted with weather proof, hot oil resistant gasket in between for complete oil tightness. If gasket is compressible, metallic stops shall be provided to prevent over-compression.
- g) The top part of the tank cover shall be sloped to prevent retention of rain water and shall not distort when lifted.
- h) The tank cover and all covers for mounting, cleaning, man -holes, hand holes and inspection openings on tank etc. shall be earthed by suitable grounding conductors of the flexible type, having a cross-section of minimum 95 mm². Appropriate earthing studs with bolts and washers, made of stainless steel shall be provided.

AXLES AND WHEELS:

- a) The transformer shall be designed with flanged bi -directional wheels and axles of a suitable size to carry the full weight of the transformer, oil and accessories. These shall be so designed as not to deflect excessively to interfere with the movement of the transformer. Wheels, axles and bearings shall be fully corrosion - resistant and complete with fittings to facilitate lubrication.
- b) Suitable locking arrangement along with foundation bolts shall be provided for the wheels to prevent accidental movement of the transformer.
- c) The wheels are required to swivel and they shall be arranged so that they can be turned through an angle of 90 degrees when the tank is jacked up to clear of rails. Means shall be provided for locking the swivel movements in positions parallel to and at right angles to the longitudinal axis of the tank.
- d) The rail track gauge shall be 5'6" (1676mm) along longer axis as well as along shorter axis.
- e) Foundation layout details will be furnished by the supplier during detailed Engineering.

ANTI-EARTHQUAKE CLAMPING DEVICE:-

To prevent transformer movement during earthquake, clamping device shall be provided for fixing the transformer to the foundation. The Successful Agency shall supply necessary bolts for embedding in the concrete foundation. The arrangements shall be such that the transformer can be fixed to or unfastened from these bolts, as desired. The fixing of the transformer to the foundation shall be designed to withstand seismic events to the extent that a static co -efficient of 0.3 g. applied in the direction of least resistance to that loading, will not cause the transformer or clamping devices as well as bolts to be over -stressed. Special steps must be taken to prevent mal-operation of Buchholz relay in such conditions.

The details of the device used and its adequacy, suitability and design calculations to withstand seismic load shall be brought out in the additional information schedule.

CONSERVATOR VESSELS, OIL GAUGES AND BREATHERS:-

- a) A conservator, complete with sump and drain valve shall be provided in such a position, so as not to obstruct the electrical connections to the transformer having a capacity between highest and lowest visible levels of 7½% of the total cold oil volume in the Transformer and the cooling equipment from minimum ambient temperature to 100 Degree C. The minimum indicated oil level shall be with the feed pipe from the main tank covered with not less than 15 mm depth of oil and the indicated range of oil level shall be minimum to maximum.
- b) If the sump is formed by extending the feeding pipe inside the conservator vessel, this extension shall be for at least 25 mm. The conservator shall be designed so that it can be completely drained by means of the drain valve provided, when mounted as in service.
- c) The conservator tank shall be bolted on to its support of mounting to allow for its removal for cleaning/repair. It shall be bolted onto the main tank to allow for its removal for cleaning/repair.
- d) The conservator for main tank shall be fitted with a magnetic oil level gauge with low oil level, electrically insulated alarm contacts. The indicator shall have the minimum and maximum levels, indicated along with the normal level at an oil temperature of 30° C. The temperature markings shall preferably be integral with the level-indicating device. The gauge should be readable from the transformer base level. Sight glasses of oil level indicators shall be of laminated security glass. Sight glasses of transparent plastics will not be accepted.
- e) Taps or valves shall not be fitted to oil gauge.
- f) The oil connection from the transformer tank to the conservator vessel shall be arranged at a rising angle of 3 to 9 degrees to the horizontal up to the Buchholz Relay and shall consist of 80 mm inside diameter pipes as per IS: 3639.
- g) A valve shall be provided at the conservator to cut off the oil supply to the transformer, after providing a straight run of pipe for at least a length of five times the internal diameter of the pipe on the tank side of the gas and oil - actuated relay and at least three times the internal diameter of the pipe on the conservator side of the gas and oil-actuated relay.
- h) The conservator tank shall be equipped with a nitrile rubber diaphragm or bag filled with dry air, which isolates the transformer oil space from the ambient air. The bag shall work satisfactorily and without damage at all anticipated oil temperatures.
- i) Provision shall be made for monitoring the integrity of rubber bag and giving an electrical alarm when the bag is damaged.
- j) The space inside the bag is to be connected to ambient air through a removable silica-gel type breather with oil trap and dust filter and mounted about 1400 mm above ground. No valve is to be placed between this breather and the conservator. The moisture absorption, indicated by change in colour of the tinted crystals inside the breather can be easily observed from distance. Minimum quantity of silica gel will be 1 Kg. for every 3500ltrs. of oil in the tank. The containers for the dehydrating agent shall be of transparent plastics. The quality of plastic material shall be got approved from the owner.
- k) The conservator for the OLTC/diverter switch can be either an integral, but completely separated part of the main conservator or a separate oil tank. It shall have a prismatic or magnetic oil level gauge.

5.3.2 VALVES AND LOCATION:

General: -

- a) Blank flanges, plates or captive screw caps shall be fitted to all valves and pipe ends, not normally connected in service.
- b) The omission of any, or the provision of alternative arrangements to the listed requirements, which alter the functional nature of the valve system, will not be accepted.

- c) All valves up to and including 100 mm shall be of gun metal. Larger valves may be of gun metal or may have cast iron bodies with gun metal fittings. They shall be of the full way type with internal screw and shall be opened by turning counter clockwise when facing the hand wheel.
- d) Means shall be provided for padlocking the valves in the open and closed positions. Provision is not required for locking individual radiator valves.
- e) Every valve shall be provided with an indicator to show clearly the position of the valve.
- f) All valves shall be provided with flanges having machined faces.
- g) All valves shall be suitable for continuous operation with transformer oil at 100° C.
- h) Suitable valves shall be provided to take sample of oil from OLTC chamber during Operation of the transformer.
- i) Oil sampling valves shall have provision to fix rubber hose of 10 mm size to facilitate oil sampling.
- j) Each transformer shall be fitted with the valves, identified in the following Sub - sections as a minimum requirement.

MAIN TANK:-

- a) One 50 mm (NW 50) bore filter valve located near to the top of the tank.
- b) One 50 mm (NW 50) bore filter valve located near to the bottom of the tank and diagonally opposite to the filter valve required against (a). Where design permits, this valve may be combined with item (c).
- c) One 50 mm (NW 50) drain valve with such arrangements as may be necessary inside the tank to ensure that the tank can be completely drained of oil as far as applicable. This valve shall also be provided with approved oil sampling device act.
- d) Two 25 mm (NW 25) oil valves for taking oil samples from the top and bottom of the tank. The top-oil sampling point shall be brought down to be accessible from ground level.
- e) A flanged 50 mm (NW 50) valve suitably positioned near the top of the main tank for the connection by the Owner of a 'Hydran' monitor.
- f) A 100 mm (NW 100) flange for the vacuum control switch tank will be provided on the tank cover.

CONSERVATOR:-

- a) One valve between the conservator and gas actuated relay for the main tank and, where appropriate, for the tap change diverter switch tank.
- b) One drain valve for oil conservator tank so arranged that the tank can be completely drained of all oil. It shall also be fitted with oil -filling hole with cap.

TAP CHANGER/DIVERTER SWITCH:-

50 mm filter and 50 mm (NW 50) drain valve where selector switches are contained in a separate tank.

RADIATORS AND COOLER BANKS:-

Valves of adequate size as per 'CBIP Manual on Transformers (Publications No. 275)' at each point of connection to the tank shall be provided.

Air release plug(s) of adequate size shall be provided.

5.3.3 JOINTS AND GASKETS:-

- a) All joint faces shall be arranged to prevent the ingress of water or leakage of oil with a minimum of gasket surface exposed to the action of oil or air.
- b) Nitrile base cork or equivalent shall be used for gaskets. Oil resistant synthetic rubber gaskets are not permissible except where the synthetic rubber is used as a bonding medium for cork or similar material or where metal inserts are provided to limit compression.
- c) Gaskets shall be consistent with the provision of a good seal and full details of all gaskets sealing

arrangement shall be shown on the drawings.

5.3.4 PRESSURE RELIEF DEVICE:-

- a) An approved pressure relief device of sufficient size shall be provided for rapid release of any pressure that may be generated within the tank and which might result in damage to the equipment. It shall positively operate, at a pressure of 7+/-1PSi (48+/- 6.8KN/Sq.mm) and automatically reset when pressure falls below this value. There will be no leakage of oil after resetting of PRD. Means shall be provided to prevent the ingress of rain or dust. Pressure relief devices of the type mounted below normal oil level shall be of the resetting type once the dangerous pressure has been reduced to prevent unnecessary release of oil.
- b) Contacts shall be provided for alarm and trip and initiation on operation of the device. Baffles shall be provided when necessary to safely control the direction in which oil or gas is ejected.
- c) Unless otherwise approved, the pressure relief device(s) shall be mounted on the main tank and if on the cover, shall be fitted with a skirt projecting 25 mm. inside the tank to prevent gas accumulation.
- d) One of the following methods shall be used for relieving or equalising the pressures in the pressure relief device.
 - (i) An equaliser pipe connecting the pressure relief device to the conservator or
 - (ii) The fitting of silica gel breather to the pressure relief device, the breather being mounted in suitable position for access at ground level.
- e) Loss of oil on operation of the relief device shall be contained within the transformer oil retaining area.
- f) The Successful Agency shall furnish constructional, design details of pressure relief device(s) and calculations to prove that the size and setting of pressure relief device(s) is adequate, considering the rating of the transformer, the quantity of oil in the Transformer and the insulating oil will not catch fire in case of any short/ground fault inside the transformer.

5.3.5 EARTHING TERMINALS:

Two substantial steel flag type terminals (each having two tapped holes with M10 bolts, plain and spring washers), capable of carrying for 5 seconds the full lower voltage short circuit current of the transformer and suitable for connection to 50 x 8 mm. Galvanised steel flat shall be located one on either side and near to the bottom of the transformer to facilitate connection to the local earthing system. The supplier shall provide earthing strips up to the ground level. Also each radiator, marshalling Kiosk, OLTC etc. shall be suitably earthed to the transformer tank or else have earthing terminals as appropriate.

5.3.6 CORROSION PROTECTION:

General:

- a) Successful Agency shall state clearly the corrosion protection, applied to aluminium and aluminium-alloy parts.
- b) Successful Agency shall draw attention to all exposed points in their equipment at which aluminium or aluminium-alloy parts are in contact with or in close proximity to other metals and shall state clearly the protection employed at each point to exclude air and moisture.
- c) A full description of the corrosion prevention system, proposed by the Bidder shall be given and this is subject to acceptance by the owner. This description shall include details of surface preparation, rust inhibition, and paint thickness, treatment of fasteners and painting of surfaces in contact with oil.

The minimum standards acceptable to the owner are:

- a) **Hot Rolled Steel:**
 - (i) Grit blasting to grade sa 2.5 of ISO 8501-1.
 - (ii) Epoxy-base zinc primer. Coating thickness 25 micrometer.

- (iii) Zinc spraying of tank bottom. Thickness 100 micrometer.
- (iv) Epoxy-based micaceous iron-oxide paint. Coating thickness 40 micrometer.
- (v) Alkyd or phenolic-based micaceous iron-oxide paint. Coating thickness-40 micrometer.
- b) Radiators and Fasteners larger than 12 mm:-
 - (i) Hot dip galvanized to IS: 2633.
 - (ii) Cleaning and surface preparation followed by paint treatment as specified above.
- c) Smaller fasteners, cable clips:-
Use of non-ferrous material, stainless steel or appropriate plated components

5.3.7 RATING, DIAGRAM AND VALVE PLATES:-

The following plates or an approved combined plate shall be fixed to each transformer Tank at an average height of 1500 mm above the ground level: -

- a) A rating plate bearing the data, specified in IEC 76 Part - I. This plate shall also include: -
 - (i) The short circuit current rating.
 - (ii) Time factor for each winding measured.
 - (iii) Measured no load current and no load losses at rated voltage and rated frequency.
 - (iv) Measured load losses at 75° C (Normal tap only).
 - (v) D.C. resistance of each winding at 75°C.
- b) A diagram plate is showing in an approved manner, the internal connections and the voltage vector relationship of the several windings, in accordance with IEC 76 Part-I with the transformer voltage ratio for each tap and, in addition, a plan view of the transformer giving the correct physical relationship of the terminals.
- c) A plate showing the location and function of all valves and air-release cocks or plugs. This plate shall also if necessary warn operators to refer to the Maintenance Instructions before applying vacuum.
- d) Current transformers Rating Plate.
- e) Diagram plate, indicating the oil levels in the conservators dependent on the oil temperature.
- f) Loading plan plate, showing transport dimensions and masses. This plate shall also warn the erection staff not to remove any cover, before filling the tank with oil to such a level where the windings are not exposed to the atmosphere. This shall be fixed directly on to the transformer tank and shall not be removed for transport.
- g) Identification plates, alpha-numerical number in an approved manner, for all fans, marshalling cabinets, breathers, valves, cocks, accessories etc. (minimum size: 110mm x 50mm) rigidly fastened by rivets on corrosion proof base plates. In addition, the function (description) of the related devices shall be clearly indicated on these plates. The alphanumeric numbers on the identification plates shall be of such a size as to be clearly legible from the floor level.
- h) Plates, showing all control, measuring and monitoring circuits and terminal blocks. These plates shall be rigidly fixed at the inner side of the hinged door of the concerned marshalling kiosk.
- i) Plates, showing the control circuit/ block diagram of the OLTC. These plates shall be rigidly fixed at the inner side of the hinged door of the motor drive cubicle.

Outdoor arranged plates are to be of polished stainless steel of top quality only (back ground clear, engraving black, depth of engraving 0.5mm) stainless steel, capable of withstanding the rigours of continuous outdoor service at site. Plates, arranged inside control and marshalling cubicles may be of material in accordance with manufacturer's standard e.g. glass-fibre reinforced synthetic resin (subject for approval). All plates other than those located on tank cover shall be easily and clearly legible from ground level.

5.3.8 CORE: -

- a) The core shall be constructed from high grade non-ageing cold rolled super grain oriented silicon steel laminations, known as HIB steel as trade name having high permeability and low hysteresis loss. B-H and specific loss curve shall be furnished in support of these materials. Laminations of

one particular thickness i.e.0.23mm. or 0.27mm. or better(quoted grade and type) shall be used. Laminations of different grade(s) and different thickness(s) are not allowed to be used in any manner or under any circumstance.

- b) After being sheared, the lamination shall be treated to remove all burrs and shall be re annealed to remove all residual stress. The insulation of the lamination, which is to be stated in the tender, shall be inert to the action of the hot transformer oil and pressure.
- c) The design of the magnetic circuit shall be such as to achieve minimum possible active and reactive core losses during the entire life of the transformer.
- d) The design of the magnetic circuit shall be such as to avoid static discharges, development of short circuit paths within itself or to the earthed clamping structure and production of flux component at right angles to the plane of laminations, which may cause local heating. The joints of limbs and yokes shall be designed and constructed to keep the no-load losses and the hot spot temperature in the magnetic core as well as the noise level as low as possible.
- e) The core and winding shall be capable of withstanding the shock during transport, installation, service and adequate provision shall be made to prevent movement of core and winding relative to tank during these conditions and reduce vibrations to a minimum for all operating conditions. Care shall also be taken to secure uniformly distributed mechanical pressure over all the laminations to prevent setting of the core and to limit noise and vibration to a minimum under service conditions.
- f) The Transformer shall be of BOLTLESS core design. The Successful Agency shall furnish the following documentary evidence towards their experience and performance in such type of design.
 1. Purchase order
 2. Approved drawings & GTP
 3. Any other documents related to boltless core design.
- g) All steel sections, used for supporting the core shall be thoroughly sandblasted after cutting, drilling and welding. Any non-magnetic or high resistance alloy shall be of established quality.
- h) When bell type construction is offered, suitable projecting guides shall be provided on core assembly to facilitate removal of tank. The supporting framework of core shall be so designed so as to avoid presence of pockets, which would prevent complete emptying of the tank through drain valve or cause trapping of air during oil filling.
- i) The core shall be provided with lugs suitable for lifting the complete core and coil assembly of the transformer.
- j) The core and coil shall be so fixed in the tank that shifting will not occur when the Transformer is moved or during a short circuit.
- k) Oil ducts shall be provided where necessary to ensure adequate cooling. The winding structure and major insulation shall not obstruct the free flow of oil through such ducts. Where the magnetic circuit is divided into pockets by cooling ducts parallel to the planes of laminations or by insulating material above 0.25 mm thick, tinned copper strip bridging pieces shall be inserted to maintain electrical continuity between pockets.
- l) The temperature gradient between the core and surrounding oil shall be maintained less than 20°C. The manufacturer shall demonstrate this either through a test (procedure to be mutually agreed) OR by a calculation.
- m) The working flux density shall not exceed 1.65 Tesla for offered no load losses and the maximum flux density in any part of core and yoke at 110% rated voltage combined with -3% frequency variation shall preferably not exceed the value of 1.9 Tesla as per CBIP manual no 295.
- n) Minimum knee point voltage is 110% of rated voltage. Accordingly, the operating flux density for design should be carefully chosen within the stipulated value to achieve the above minimum knee point voltage. The Bidder shall quote the practical achievable no load current at different percentages of rated voltage as per Guaranteed Technical Particulars along with a linear graph confirming the above said knee point voltage which will be verified during no load test method that 10% increase in voltage from 110% rated voltage causes the excitation current to

increase not by more than 50%.

- o) The Successful Agency will offer the core for inspection and approval by the Owner during manufacturer's stage. Successful Agency's notice for this purpose shall be accompanied with the following documents towards use of prime core.
 - (i) Invoice of the supplier.
 - (ii) Mill's Test Certificates
 - (iii) Packing list.
 - (iv) Bill of lading.
 - (v) Bill of entry certificates by customs.
- p) Core material shall be directly procured either from the manufacturer or through their accredited marketing organizations of repute and not through any agent. **All the core import documents must be in the name of the transformer manufacturer.**
- q) The Transformer manufacturer should preferably have in-house core-cutting facility for proper monitoring and control on quality and also to avoid any possibility of mixing of prime material with defective/ second grade material.

The following procedure is to be adopted for those manufacturers who have no in-house core-cutting facility:

1. In the offer, the bidder should mention names of at least three manufacturers of Transformer core material who have at least 5 (five) years' experience in manufacturing of Transformer grade core. The Transformer manufacturer (TM) can purchase the core from such manufacturer(s) for which approval will be accorded by OPTCL.
2. The bidder should specify the grade, thickness of core material in the offer along with submission of all graphs/ documents, relating to the grade of core material, offered by them.
3. The documents, as mentioned against Sl. '0' should be submitted to TFL, Once the core materials are landed in any of the Indian ports and same should be offered to TFL for inspection. The representative, deputed by TFL for such inspection will record the following information: -
 - a) Purchase order No. & Date.
 - b) No. of packed coils with package Nos.
 - c) Gross weight.
 - d) Net weight
 - e) Port of loading.
 - f) Port of discharge.
 - g) Name of the ocean vessel.
 - h) Grade and thickness of core material.
 - i) Any other information, as mentioned on the body of packed coils.
4. The bidder in its offer will mention the names of at least three Sub-vendors, to whom they intend to assign their core cutting. Such sub -vendors should have been approved by other Electricity Boards/ Electrical utilities and are accredited by some International recognised certification body like ISO: 9000 etc., to ensure that a minimum quality parameters and tolerances are maintained. The experience, the details of core-cutting facilities, finishing and testing facilities etc., as available with such sub-vendors should be clearly outlined in the bid.
5. On award of contract, the TM is to assign the core-cutting to such sub-vendor(s) for which approval is to be given by OPTCL.
6. After the packed core coils are received by the OPTCL's approved sub-vendors the TM is to offer the same to OPTCL for deputing representative(s) to first note down the details as per SL (3) above and witness the cutting of cores and relevant tests on core samples.
7. The TM will offer the core materials for inspection during assembly stage and witnessing the stage inspection and relevant tests.
8. Successful Agency shall furnish during detailed engineering the calculation towards Air -core reactance of H.V. winding and maximum peak value of magnetising in - rush current and shall justify that the transformer will not trip due to this during initial charging and subsequent charging.

9. Successful Agency shall furnish during detailed engineering the calculation towards Air -core reactance of H.V. winding and maximum peak value of magnetising in -rush current and shall justify that the transformer will not trip due to this during initial charging and subsequent charging. The formula & basis for calculation of air core reactance is to be justified during design review.

EARTHING OF CORE CLAMPING STRUCTURE:

The top main core clamping structure shall be connected to the tank body by a copper strip. The bottom clamping structure shall be earthed by one or more of the following methods: -

- a) By connection through vertical tie-rods to the top structure.
- b) By direct-metal-to metal contact with the tank base maintained by the weight of the core and windings.
- c) By a connection to the top structure on the same side of the core as the main earth connection to the tank.

EARTHING OF MAGNETIC CIRCUITS:

- a) The magnetic circuit shall be earthed to clamping structure at one point only through a removable link, placed in an accessible position just beneath an inspection opening in the tank cover and which, by disconnection, will perform the insulation resistance test between the core and clamping plates etc. to be tested at voltages up to 2.0KV(rms). The removable link shall have adequate section to carry ground fault current.
- b) When magnetic circuits are subdivided into separate isolated sections by ducts perpendiculars to the plane laminations, all such sections shall be earthed.

SIZE OF EARTHING CONNECTIONS:-

To be proposed by the manufacturer for the owner's approval.

5.3.9 WINDINGS:-

- a) The supplier shall ensure that the windings of all EHV class transformers are made in dust proof conditioned atmosphere. He shall furnish the facilities, available in this regard at his works along with the bid.
- b) The windings for system rated voltages of 220 KV shall have graded insulation, as defined in IEC-76 and IS-2026. The winding for 33 KV shall be fully insulated.
- c) The neutral ends of star connected three phase windings shall be connected at points, which are accessible from manholes in the cover and brought out via one bushing.
- d) The conductors for the windings and connecting leads shall be of electrolytic grade copper, free from scales and burrs and shall have properly rounded corners to reduce electrostatic flux concentration.
- e) The current density, adopted for all the windings shall not exceed 2.8 Ampere/sq.mm. The total net cross-sectional area of the strip conductors for calculating the current density for each winding shall be obtained after deducting the copper area, lost due to rounding up of the sharp edges of the rectangular conductors.
- f) The copper conductors, used in the coil structure shall be best suitable to the requirements and all permanent current carrying joints of the windings and the leads shall be welded or braced or crimped.
- g) The coils shall be supported between adjacent sections by insulating spacers and the barriers, bracings and other insulation, which shall be arranged to ensure a free circulation of the oil and to reduce hot spots in the windings. The stacks of windings shall receive adequate shrinkage treatment before final assembly. Adjustable devices shall be provided for taking up any possible shrinkage of coils in services.
- h) The transformer shall be designed to withstand impulse and power frequency test voltages as

specified in IEC 76 and IS: 2026.

- i) The windings shall be capable of withstanding axial and radial forces during fault conditions as per clause No. 5.1.
- j) The short circuit temperature rise should not exceed the limits, fixed as per IS: 2026.
- k) The insulation of transformer windings and connections shall be free from insulating compounds which are liable to soften, ooze out, shrink or collapse or be catalytic and chemically active in the hot transformer oil during service. The dielectric strength of winding insulation shall conform to the values, given in IS: 2026, as amended up to date.
- l) The coil clamping arrangement and the finished dimensions of any oil duct shall be such as will not impede the free circulation of oil through the ducts.
- m) No strip conductor wound on edge shall have a width exceeding six times its thickness.
- n) The conductors shall be transposed at sufficient intervals in order to minimize eddy currents and equalize the distribution of currents and temperatures along the windings.
- o) The windings and leads of all transformers shall be able to withstand the shocks, which may occur through rough handling and vibration during transport, switching and other transient service conditions including external short circuit. Adequate barriers shall be provided between windings and core and between windings. All leads or bars from the windings to the terminal boxes and bushings shall be rigidly supported. Stresses on coils and connections must be avoided.
- p) The windings shall be located in a manner, which will ensure that they remain electro-magnetically balanced and their magnetic centres remain co-incident under all conditions of operations.
- q) Tappings shall be so arranged as to preserve the magnetic balance of the transformer at all voltage ratios.
- r) The coils should be made up, shaped and braced to provide for expansion and contraction due to temperature changes.
- s) Coil clamping rings, if provided, shall be of steel or of suitable insulating material.
- t) All threaded connections shall be provided with locking facilities. All leads from the winding to the terminal board and bushing shall be rigidly supported to prevent injury from vibration. Guide tubes shall be used, where practicable.
- u) The assembled core and windings shall be vacuum dried and suitably impregnated before removal from the treating tank.
- v) Where coil-clamping rings are of metal at earth potential, each ring shall be connected to the adjacent core clamping structure on the same side of the transformer as the main earth connection. However, same shall be proposed by the manufacturer for the owner's approval.
- w) Washers in contact with non-ferrous parts, which carry current, shall be of phosphorous bronze.
- x) The Transformer Manufacturer should have in house availability of vapour phase Drying (VPD) plant for proper drying of the insulation. In case VPD facility is not available, the Transformer Manufacturer / Successful Agency will prove that the method of drying adopted by them is equivalent or better than VPD in terms of level of dryness and other benefits of VPD.
- y) The air-core reactance of HV winding of Transformer shall not be less than 20%.
- z) The transformer shall be designed to withstand a DC current of 10A per phase without injurious heating.
- aa) Tan delta value for windings shall be less than 0.005. Tan delta shall be measured at ambient temperature. No temperature correction factor shall be applied.
- bb) The arrangement of the core and windings shall be in the following manner: -
CORE-LV-HV-REGULATING

5.3.10 GAS AND OIL-ACTUATED RELAYS:-

- a) Each transformer shall be fitted with gas and oil-actuated relay equipment having alarm contacts, which close on collection of gas or low oil level, and tripping contacts which close following oil surge conditions. Separate relays shall be provided for on load tap changer.
- b) Each gas and oil-actuated relay shall be provided with a test cock to take a flexible pipe connection for checking the operation of the relay.
- c) Each relay shall be fitted with a calibrated glass window for indication of gas volume.
- d) To allow gas to be collected at ground level, a small bore pipe shall be connected to the gas release cock of the gas and oil-actuated relay and brought down to a point, approximately 1400 mm above ground level,. Where it shall be terminated by a cock, which shall have provision for locking to prevent unauthorized operation.
- e) The design of the relay mounting arrangements, the associated pipe work and the cooling plant shall be such that mal-operation of the relay will not take place under normal service conditions, including starting or stopping of oil circulating pumps whether by manual or automatic control under all operating temperatures.
- f) The pipe work shall be so arranged that all gas arising from the transformer will pass into the gas and oil-actuated relay. The oil circuit through the relay must not form a delivery path in parallel with any circulating oil pipe, nor is to be tied into or connected through the pressure relief vent. Sharp bends in the pipe work shall be avoided. For this reason, bushing turrets, if fitted shall have vent pipes, which will route any gas collection through the relay.
- g) A machined surface shall be provided on the top of each relay to facilitate the setting of the relays and to check the mounting angle in the expansion pipe and the cross level of the relay.
- h) A straight run of pipe work shall be provided for a length of five times the internal diameter of the pipe on the conservator side of the gas and oil -actuated relay.
- i) The surge float contacts shall close at a rate of steady oil flow between the following limits. As far as possible, the limits shall also be met when the relay is subjected to oil surge conditions, produced by rapid opening of a lever operated gate valve.
- j) The relays shall be so located as to be easily accessible from the top of the tank.
- k) The gas collection contacts shall operate within the angle limits, specified for test:
- l) When a transformer is provided with two conservators, the gas and oil - actuated relays shall be arranged as follows:
 - (i) If the two conservators are piped separately to the transformer, two relays shall be installed, one in each pipe connection.
- m) The clearance between oil pipe work and live metal shall be not less than the minimum clearances as per standard practice.

5.3.11 TEMPERATURE INDICATING DEVICES AND ALARMS: -

The Transformer shall be provided with approved devices for indicating the oil temperature and hot spot winding temperature of each winding. The devices shall have a dial type indicator and in addition, a pointer to register the highest temperature reached and re-setting device. Each temperature device shall have three separate contacts fitted, one of which shall be used to control the cooling plant motors, one to give an alarm and one to trip the associated circuit breakers.

a) Oil Temperature Indicator (OTI)

The thermometer for top oil temperature indication should be of 150mm. dial type. A temperature-sensing element, suitably located in a pocket on top oil shall be furnished. This shall be connected to the OTI by means of capillary tubing. Accuracy class of OTI shall be $\pm 1.5\%$ or better. The temperature indicator dials shall have linear graduations to clearly read at least every 2 deg. C.

b) Winding Temperature Indicator (WTI)

A device for measuring the hot spot temperature of each of the HV/LV windings shall be provided. It shall comprise of the following:-

- (i) Temperature sensing element.
- (ii) Image Coil.
- (iii) Auxiliary CTS, if required to match the image coil, shall be provided and mounted in the cooler control cabinet. For autotransformers, an additional CT is required in the lead to the primary terminal to give a true image of the temperature in the common/secondary winding. The current transformers shall be of class 1, and the rated primary current shall correspond to the rated current of the related transformer winding. The effective resulting rated secondary current shall be 2A. Matching units between current transformers and thermal replicas shall not be provided.
- (iv) 150 mm diameter local indicating instrument with maximum reading pointer, mounted in cooler control cabinet and with two adjustable electrically independent ungrounded contacts (besides that required for control of cooling equipment), one for high winding temperature alarm and one for trip. The temperature indicator dials shall have linear graduations to clearly read at least 2 deg. C
- (v) In addition to the above, the following indication equipment shall be provided for each winding for remote indication.
 - 1) Conventional Remote winding temperature indicator & Remote Oil temperature indicator: - It shall be suitable for flush mounting on RTCC panel. The difference between local and remote indication at any given time shall not exceed 1 deg. C through transducer.
 - 2) Auxiliary supply, if required, in RTCC panel, for above, shall be 220V DC only.
 - 3) The drawing showing details of above shall be submitted to the owner.
 - 4) Accuracy class of WTI & OTI shall be $\pm 1.5\%$ or better.
 - 5) Any special cable(s), required for shielding purpose for connection between cooler control cabinet and remote winding temperature indicator control circuit shall be in Bidder's scope.
- c) The winding temperature indicators shall be housed in the cooler control cabinet/marshalling kiosk. The tripping contacts of the winding temperature indicators shall be adjustable to close between 80°C and 150°C and to re-open when the temperature has fallen by not more than 10°C.
- d) The alarm contacts and the contacts used to control the cooling plant motors on the above devices shall be adjustable to close between 50°C and 100°C and to re-open when the temperature has fallen by a desired amount between 10° C and 15° C.
- e) All contacts shall be adjustable to a scale and must be accessible on removal of the relay cover. Alarm and trip circuit contacts shall be suitable for making or breaking 150 VA between the limits of 30 and 250 Volts AC or DC and of making 500 VA between the limits of 110 and 250 V DC. Cooler motor control contacts shall be suitable for operating the cooler contactors direct, or if

necessary, through an interposing relay.

- f) The temperature indicators in the marshalling kiosk shall be so designed that it is possible to move the pointers by hand for the purpose of checking the operation of the contacts and associated equipment.
- g) The working parts of the instrument shall be made visible by the provision of cut-away dials and glass-fronted covers. All setting and error adjustment devices shall be easily accessible.
- h) Connections shall be brought from the device to terminal boards, placed inside the marshalling cubicle.
- i) Terminals, links and a 63 mm moving iron ammeter shall be provided in the marshalling kiosk for each WTI for: -
 - a) Checking the output of the current transformer.
 - b) Testing the current transformer and thermal image characteristics.
 - c) Disconnecting the bulb heaters from the current transformer secondary circuit to enable the instrument to be used as an oil temperature indicator.
- j) Sight glasses of temperature indicators shall be of laminated security glass. Sight glasses of transparent plastics will not be accepted.

5.3.12 COOLLING EQUIPMENT AND ITS CONTROLS:

Cooling Equipment:

- a) The Cooler shall be designed using 2 x 50 % radiator banks.
- b) Each radiator bank shall have its own cooling fans, shut off valves, lifting lugs, top and bottom oil filling valves, air release plug, a drain valve and thermometer pocket, fitted with captive screw cap on the inlet and outlet oil pipes.
- c) One stand by fan of at least 20% capacity shall also be provided and identified with each radiator bank.
- d) Cooling fans shall not be directly mounted on radiator bank which may cause undue vibrations. Each fan shall be suitably protected by galvanized wire guard.
- e) The exhaust airflow from cooling fan shall not be directed towards the main tank in any case.
- f) Cooling fans for each radiator bank shall be located so as to prevent ingress of rainwater.
- g) It shall be possible to remove the blower complete with motor without disturbing or dismantling the cooler structure framework.
- h) The blades of cooling fans shall be of galvanised steel or cast aluminium alloy unless otherwise approved. Thickness of galvanization shall be minimum 55 microns.
- i) Blower casings shall be made of galvanised steel of thickness not less than 2 mm or aluminium alloy and shall be suitably stiffened by angles or tees.
- j) Galvanised wire guards with mesh not exceeding 12.5 mm shall be provided to prevent accidental contact with the blades. Guards shall also be provided over all moving parts. Guards shall be designed such that blades and other moving parts cannot be touched by test fingers to IEC - 529:1976 (BSEN60529). Direction of rotation shall be indicated.
- k) Cooling fan motors shall be suitable for operation from 415 volts, three phase and 50 Hz power supply and shall conform to IS: 325. The motor winding enclosure - equivalent to IP: 55 as per IS: 4691.
- l) Each cooling fan motor shall be provided with starter thermal overload and short circuit protection.
- m) Each radiator shall be provided with the following items: -**
 - One shut off valve at the top.
 - One shut-off valve at the bottom.
 - Air release device at the top.
 - Lifting lugs to lift entire cooling assembly.
 - Air release device and oil plug on oil pipe connections.
 - Loose blanking plates for blanking off the main oil connections.

- Visual oil flow indicators, fitted with the electrical contacts to close when oil is not flowing. Contacts are to be connected in the cooler fail alarm circuit.

Each radiator bank shall be provided with the following items: -

- Main and sampling device at the bottom.
 - Expansion joints, one each on top and bottom cooler pipe connections.
 - A thermometer pocket fitted with captive screw cap, in the inlet and in the out let oil pipes.
- n) Coolers shall be so designed as to be accessible for cleaning and painting to prevent accumulation of water on the outer surfaces to completely drain oil in the tank and to ensure against formation of gas pockets when the tank is being filled.**

o) OIL PIPES AND FLANGES :

- All oil piping, necessary for connecting of each transformer to its conservator, cooler banks etc. shall be supplied under this contract.
- The oil piping shall be of approved material with machined flanged joints.
- Copper pipe work is to comply with BS.61.
- Dimensions of steel pipes shall be in accordance with BS. 3600: 1973 and the drilling of all pipe flanges shall comply with BS: 4504:1969.
- An approved expansion piece shall be provided in each oil pipe connection between the transformer and each oil cooler bank.
- All necessary pipe supports, foundation bolts and all other attachments are to be provided.
- It shall be possible to drain any section of pipe work independently of the rest and drain valves or plugs shall be provided as necessary to meet this requirement

N. B.: - The omission of any or the provision of alternative arrangements to the above requirements will not be accepted.

COOLING EQUIPMENT CONTROL (ONAN/ONAF COOLING):-

- Automatic operation control (switching in and out) of fans shall be provided (with temperature change) from contacts of winding temperature indicator. The supplier shall recommend the setting of WTI for automatic changeover of cooler control from ONAN to ONAF. The setting shall be such that hunting i.e., frequent start operations for small temperature differential do not occur.
- Suitable manual control facility for cooler fans with manual/automatic select or switches and push buttons shall be provided.

INDICATING DEVICES:-

Following lamp indications shall be provided in cooler control cabinet.

- Fan 'ON' Fan 'OFF'
- Cooling system 'On Automatic Control'
- Cooling system 'On Manual'
- Selector Switch in 'Auto' or 'Manual' for each fan
- 415 volts cooler supply auto changeover.
- Cooler supply failure for each supply.
- Cooling fan failure for each fan.
- Control supply failure for main and stand by.
- One potential free initiating contact for all the above indications shall be wired independently to the terminal blocks of cooler control cabinet exclusively for Owner's use.
- A 12-window annunciator shall be provided in the RTCC panel for visual and audible signalling of important functions of cooling equipment and tap changer.
- This Annunciator shall provide repeat contact for SAS signal.

COOLER CONTROL CABINET:

- a) Each transformer unit shall be provided with a cooler control cabinet.
- b) The cooler control cabinet shall have all necessary devices, meant for cooler control and local temperature indicators. All the contacts of various protective devices, mounted on the transformer shall also be wired up to the terminal board in the cooler control cabinet. All the secondary terminals of the bushing CTs shall also be wired up to the terminal board at the cooler control cabinet.
- c) The cooler control cabinet shall have two (2) sections. One section shall have the control equipment, exclusively meant for cooler control. The other section shall house the temperature indicators, auxiliary CTs. and the terminal boards, meant for termination of various alarm and trip contacts as well as various bushing CT Secondaries. Alternatively, the two sections may be provided as two separate panels, depending on the standard practices of the supplier.
- d) The temperature indicators shall be so mounted that the dials are not more than 1600 mm from ground level. Glazed door of suitable size shall be provided for convenience of reading.

TERMINAL BLOCK:

- a) The terminal blocks ('Elmex' Make, Type – OAT 6 or its equivalent), to be provided shall be fully enclosed with removable covers and made of moulded, non-inflammable plastic material with block and barriers, moulded integrally. Such block shall have washer and binding screws for external circuit wire connections, a white marking strip for circuit identification and moulded plastic cover. All terminals shall be clearly marked with identification numbers or letters to facilitate connection to external wiring.
- b) All internal wiring to be connected to the external equipment shall terminate on terminal blocks, preferably vertically mounted on the side of each panel. The terminal blocks shall be 1100 V grade and have 10 Amps continuous rating moulded piece, complete with insulated barriers, non-disconnecting stud type terminals, washers, nuts and lock nuts. Terminal block design shall include a white fibre-marking strip with clear plastic, slipon/clipon terminal cover. Markings on the terminal strips shall correspond to wire number and terminal numbers on the wiring diagrams.
- c) Terminal blocks for current transformer's secondary leads shall be provided with test links and isolating facilities. Also current transformer secondary leads shall be provided with short-circuiting and earthing facilities.
- d) At least 20% spare terminals shall be provided on each panel and these spare terminals shall be uniformly distributed on all terminal blocks.
- e) Unless otherwise specified, terminal blocks shall be suitable for connecting the following conductors on each side.
- f) For all circuits except current transformer circuits, minimum of two nos. 2.5 sq.mm copper.
 - (i) For all CT circuits, minimum of two nos. 4 sq. mm. copper.
- g) There shall be a minimum edge-to-edge clearance of 250 mm. between the first row of terminal block and the associated cable gland plate. Also the clearance between two rows of terminal blocks shall be minimum of 150 mm.
- h) Arrangement of the terminal block assemblies and the wiring channel within the enclosure shall be such that a row of terminal blocks is run parallel and in close proximity long each side of the wiring duct to be provided for convenient attachment of internal panel wiring. The side of the terminal block, opposite the wiring adjacent terminal blocks shall also share this field-wiring corridor. A steel strip shall be connected between adjacent terminal block rows at 450 mm intervals for support of incoming cables.
- i) The number and sizes of the owner's multi core incoming cable will be furnished to the Successful Agency after placement of the order.

LABELS:

- a) Labels shall be provided for all the apparatus such as relays, switches, fuses etc., contained in control cabinets/marshalling box.
- b) Description labels for mounting indoor or inside control cabinets/marshalling box shall be of such material that will ensure permanence of lettering. A matt of satin finish shall be provided to avoid dazzle from reflected light. Labels, mounted on dark surfaces shall have white lettering on a black background. All plates shall be of a material, which will not get corroded.
- c) Labelling shall be clear, concise and adequate.
- d) Labels shall be supplied as far as possible in the following four standard sizes
 - (i) Label for fuses and links shall measure approximately 28mm. to 45mm by 13mm. to 19mm. and lettering of 3mm to 6mm. Shall be used according to the amount of inscription required. The lettering shall have strokes of approximately 1mm. width.
 - (ii) Labels for relays, contactors, thermal devices and similar apparatus shall measure 65mm. by 20mm. and shall have lettering as specified in (i) above.
 - (iii) Labels for controllers and changeover switches shall measure 70mm. By 30 mm and where practicable have 20 mm lettering with 1.5 mm strokes.
 - (iv) The labels for the doors of junction boxes, marshalling boxes and similar equipment shall measure 125 mm x 50 mm and have 13 mm, lettering with 1.5 mm wide strokes.
- e) The labels for mounting outdoor shall be weather and corrosion proof. The letters/diagrams thereon shall be framed by etching or other such process, which will ensure permanence of the lettering/markings.
- f) Labels shall be attached to panels with brass screws or with steel screws which have received rust preventive treatment.

5.3.13 VOLTAGE SELECTION AND CONTROL :

On load tap changers:

General:

- a) The OLTC shall be of In Tank, Hi Speed Resistor type.
- b) OLTC gear shall be motor-operated for local as well as remote electrical operation. An external hand wheel/handle shall be provided for local manual operation.
- c) On-load tap-changer shall be sourced from reputed manufacturer and it should be type tested as per relevant IEC-60214 and test methods shall be in full conformance to the procedures, indicated in IEC-60214.
- d) The details of the method of diversion of the load current during tap -changing, the mechanical construction of the gear and control features of OLTC gear shall be submitted by the successful Agency. Information regarding the service experience on the gear and a list of important users shall be furnished. The tap-changer shall change the effective transformation ratio without producing phase displacement.
- e) The current diverting contacts shall be housed in a separate oil chamber, not communicating with the oil in the main tank of the transformer. On load tap changer shall have maximum rated through current to meet the normal rated load as well as over -load as per standards. The OLTC should also be suitable for an occasional switching at 200% of the OLTC rating as per IEC-60214 which shall be validated with by the type test. The OLTC shall have BIL rating and short circuit withstand current as per relevant IEC standards.
- f) All terminals shall be clearly and permanently marked with numbers corresponding to the cables connected thereto.
- g) Tap positions shall be numbered consecutively ranging from one upwards. Tap one being the highest voltage ratio.
- h) Current rating and voltage steps shall be as specified.
- i) On-load tap changers shall comply with IEC 214:1976 and BS: 4571:1970 and shall be suitable for power flow in both the directions. **The type test certificates as per the above standards shall be submitted by the successful Agency.**

- j) Current making and breaking switches, associated with the tap selectors shall be contained in a tank in which the head of oil is maintained by means, completely independent of that on the transformer itself.
- k) Details of maintaining oil separation, oil levels, oil draining/filling/sampling, and detection of oil surges and provision of alarm and trip contacts will be dependent on the design of tap-changer and be to the approval of the owner. However, a suitable pressure relief device shall be provided for all on-load tap changer compartments. It should be possible to inspect the diverter switch contacts without having to lower the oil in the transformer. Contact tips should be replaceable.
- l) Transformer on load tap changers shall be equipped with a fixed resistor network, capable of providing discrete voltage steps for input to the supervisory system.
- m) The successful Agency shall indicate the safeguards in order to avoid harmful arcing at the current diverting contacts in the event of operation of the OLTC gear under overload conditions of the transformer.
- n) Any 'DROP DOWN' tanks, associated with the tap changing apparatus shall be fitted with guide rods to control the movements during lifting or lowering.
- o) All relays and operating devices shall operate correctly at any voltage between the limits specified.
- p) The OLTC shall be suitably protected through oil surge relay. This surge relay shall be tested for an oil flow velocity of 1.20 +/- 0.20 m/s.

MECHANISMS:

- a) The drive mechanism chamber shall be mounted on the tank in an accessible position. It should be adequately ventilated and provided with anti-condensation metal clad heaters with thermostatic control. All components inside shall be protected against corrosion, deterioration due to condensation, fungi etc. The door shall be pad-lockable.
- b) The tap change mechanism shall be designed in such a way that when a tap change has been initiated, it will be completed independently of the operation of the control relays and switches. If a failure of the auxiliary supply during tap change or any other contingency would result in that movement, not being completed, an approved means shall be provided to safeguard the transformer and its auxiliary equipment.
- c) Limit switches shall be provided to prevent over-running of the tap changing mechanism. These shall be directly connected in the operating motor circuit. In addition, mechanical stops shall be fitted to prevent over-running of the mechanism under any condition. For on-load tap change equipment, these stops shall withstand the full torque of the driving mechanism without damage to the tap change equipment. Limit switches may be connected in the control circuit of the operating motor, provided that a mechanical de-clutching mechanism is incorporated.
- d) Thermal devices or other approved means shall be provided to protect the motor and control circuit.
- e) A permanently legible lubrication chart shall be provided and fitted inside the tap-changing chamber.

TAP CHANGE CONTROL PHILOSOPHY:-

General:

The following operating conditions are applicable to the on-load tap changer controls:-

- a) It must not be possible to operate the electric drive when the manual operating gear is in use.
- b) It must not be possible for two electric control points to be in operation at the same time.
- c) Operation from a control switch shall cause one tap movement only unless the control switch is returned to the off position between successive operations. Subsequent tap Changes shall be initiated only by a new or repeat command.
- d) It shall not be possible for any transformer operating in parallel with one or more other transformers in a group to be more than one tap out of step with the other transformers in the group. On load tap changers shall be equipped with a time delayed INCOMPLETE STEP alarm,

consisting of a normally open contact which closes if the tap changer fails to make a complete tap change. The alarm shall not operate for momentary loss of auxiliary power.

- e) All electrical control switches and local manual operating gear shall be clearly labelled in an approved manner to indicate the direction of tap changing i.e., raise and lower tap number.

Manual Control:

- a) The cranking device for manual operation of the OLTC gear shall be removable and suitable for operation by a man, standing at ground level.
- b) The manual control shall be considered as back up to the motor operated control and shall be inter locked with the motor to block motor start up during manual operation. The manual operating mechanism shall be labelled to show the direction of operation for raising the terminal voltage and vice-versa.
- c) Manual tap position indicator which shall be complete with the following: -
 - (i) Mechanical tap position indicator which shall be clearly visible from near the transformer.
 - (ii) A mechanical operation counter.
 - (iii) Mechanical stops to prevent over-cranking of the mechanism beyond the extreme tap positions.

Local and Remote Control:

Equipment for local, manual and electrical operation shall be provided in an outdoor cubicle. Electrical remote control equipment shall also be supplied on the tap changer. The following control facilities shall be provided: -

- a) ‘Local-Remote’ selector switch, mounted in local OLTC, Control cabinet. When the selector switch in ‘Local’ position, it shall be possible to operate the ‘raise-lower’ control switches, specified in (b) below. Remote control of the raise - lower functions shall be inhibited. When the selector switch is in ‘Remote’ position the local OLTC control cabinet mounted ‘Raise-Lower’ switch specified in clause (b) below shall be inoperative. Remote control of the Raise/Lower function shall be possible from the remote control panel. The ‘local-remote’ selector switch shall have at least two spare contacts per position, which are closed in that position, but open in the other position.
- b) A ‘Raise-Lower’ Control switch/push button shall be provided in the local OLTC control cabinet. This switch shall be operative only when ‘local-remote’ selector switch is in ‘local’ position.
- c) An ‘ON-OFF’ tap changer control switch shall be provided in the local OLTC control cabinet of the transformer. The tap changer shall be in operative in the ‘OFF’ position. The ‘ON-OFF’ switch shall have at least one spare contact per position which is closed in that position, but open in the other position.

Remote group control:-

The offered OLTC control scheme shall have provision of remote electrical group control during the parallel operation of transformer. This is in addition to independent control of OLTC.

- (a) A four position selector switch having ‘Master’, Follower’, ‘Independent’ and ‘Off’ position shall be provided in the remote OLTC control panel for each transformer. This shall be wired to enable operator to select operation of OLTC in either ‘Master’, ‘Follower’, ‘Independent’ or, ‘Off’ mode.
- (b) Out of step relays with timer contacts shall also be provided to give alarm and indication in case tap position in all the transformers under group control are not in same position.
- (c) Master Position: If the selector switch is in Master position, it shall be possible to control the OLTC units in the OLTC units in the follower mode by operating the controls of the master unit. Independent operation of the units under Follower mode shall be prevented. However, the units under Independent mode will be controlled independently.

(d) Follower Position: - If the selector switch is in follower mode, control of OLTC shall be possible only from panel of the Master Unit.

(e) Independent Position: - In this position of selector switch, control of OLTC of individual unit only shall be possible.

Control Circuits:-

The control circuits shall comply with following conditions:-

- a) An interlock to cut off electrical control automatically upon recourse being taken to the manual control.
- b) Re-enforcement of the initiating impulse for a tap changer, ensuring a positive completion, once initiated to the next (higher or lower) tap.
- c) “Step-by-Step” operation ensuring only one tap change from each tap changing impulse and a lockout of the mechanism if the control switch (or push button) remains in the “operation” position.
- d) An interlock to cut out electrical control when it tends to operate the gear beyond either of the extreme tap positions.
- e) An electrical interlock to cut-off a counter impulse for reverse step change being initiated during a progressing tap change and until the mechanism comes to rest and resets circuits for the new position.
- f) Tap change in progress indication shall be provided by means of an indicating lamp at the owner’s control panel. Necessary contacts for this and for remote tap position indicator at owner’s control panel shall be provided by the successful Agency.
- g) Protective apparatus, considered essential by the Bidder according to specialties of the gear.

Indications: -

Apparatus of an approved type shall be provided on each transformer: -

- a) To give indication mechanically at the transformer and electrically at the remote control point of the number of the tapping in use.
- b) To give electrical indication, separate from that specified above, of tap position at the remote supervisory point. Suitable tap position transducer to be incorporated for indication.
- c) To give indication at the remote control point and at the supervisory control point that a tap change is in progress, this indication to continue until the tap change is complete.
- d) To give indication at the remote control point and at the supervisory control point when transformers operating in parallel are out of step.
- e) To indicate at the tap change mechanism the number of operations, completed by the equipment. A six digit counter should be provided for this.

LOCAL CONTROL CABINET: -

The local OLTC control cabinet shall house all necessary devices, meant for OLTC control and indication. It shall be complete with the following: -

- a) A circuit breaker/contactors with thermal overload devices for controlling the A.C. auxiliary supply to the OLTC motor.
- b) Cubicle light with door switch.
- c) Space heaters to prevent condensation.
- d) Padlocking arrangement for hinged door of cabinet.
- e) Cable terminal glands for power and control cables to the OLTC gear.

REMOTE CONTROL PANELS:-

- a) All controls, alarms and indications for transformers shall be incorporated within the appropriate

switchgear control panels. The supplier shall provide all indications, relays, switches etc. for remote indication and operation of the transformer from the substation control room. Comprehensive and detailed instructions shall be provided to the owner regarding correct installation of this remote panel.

- b) The remote tap changer control panel shall be mounted in the owner's control room. Size and colour of the panel shall be to the approval of the owner.
- c) Operation of remote control scheme shall be entirely suitable for the distance between the transformer and remote control panel. Details of the connection of the remote control panel to the transformer shall be provided by the supplier.
- d) The standard requirements (which may be varied to suit manufacturer's design) shall be outlined in the following sub-clauses.

INSTRUMENTS:

- a) Voltmeter (voltage at the low voltage terminals of the transformer).
- b) Tap position indicator
- c) Conventional winding & oil temperature indicator.

CONTROLS:

- a) Automatic/non-automatic voltage control selector switch.
- b) Remote/supervisory tap change control selector switch.
- c) Raise/lower push-buttons.
- d) Independent/Master/Follower selector switch.

INDICATIONS AND ALARMS:

- a) Tap changer on manual control - white lamp.
- b) Tap change in progress - white lamp.
- c) Tap change out of step-alarm.
- d) Cooling equipment running-white lamp.
- e) Cooling equipment failure-alarm.
- f) AVR reference voltage failure-alarm.
- g) Tap changer supply voltage failure-alarm.
- h) Tap change incomplete step-alarm.

RELAYS:

- a) Automatic Voltage Control.

AUXILIARY SUPPLY FOR OLTC CONTROL AND POWER CIRCUIT:-

Auxiliary supplies as indicated in the specification will be provided by the owner at any one place. All loads shall be fed by one of the two feeders through an electrically interlocked automatic transfer switch, housed in the marshalling Kiosk. The design feature for the transfer switch shall include the following: -

- a) Provision for the selection of one of the feeders as normal source and the other as standby.
- b) Upon failure of normal source, the loads shall be automatically transferred after an adjustable time delay to the stand by source.
- c) Indication for failure of the normal source and for transfer to standby source and also for failure to transfer shall be provided locally as well as at the remote control panel.
- d) Automatic re-transfers to normal source with an adjustable time delay following Re-energisation of the normal source.
- e) Both the transfer and the re-transfer shall be dead transfers and AC feeders shall not be paralleled at any time.
- f) Necessary isolating switches, MCBs and other components for the above power supply transfer arrangement shall be provided by the supplier.

5.3.14 SUPERVISORY CONTROL:-

General:-

- a) Tap change control equipment shall be suitable for supervisory control and indication with make before break multi-way switch having one potential free contact for each tap position. This switch shall be provided in addition to any other switch/switches, which may be required in remote tap position indication.
- b) Transformer on-load tap changer shall be equipped with a fixed resistor network, capable of providing discrete voltage steps for input to the supervisory system.
- c) Transformer tap change control will be effected from the sub-station control room with facilities for remote control from the SAS. Provision for such supervisory control shall be included in this contract.
- d) The supervisory facilities, outlined in the following sub-clauses will be required and control circuit design must make provision for these.

CONTROLS:

- a) Tap change control remote/supervisory select/deselect:-
N.B.:- Selection of supervisory control shall render voltage control non-automatic.
- b) Tap position Raise/lower.

INDICATIONS AND ALARMS:

- a) Tap change remote/supervisory indication.
- b) Tap position indication through appropriate transducer.
- c) Tap change out of step alarm.
- d) Tap changer auto/non-auto indication.
- e) Independent/master/follower indication.
- f) Tap change in progress indication.
- g) AVR reference voltage failure alarm.
- h) Tap changing incomplete (TCINCL).
- i) Tap changer supply failure alarm.
- j) Cooling equipment running indication.
- k) Cooling equipment failure alarm.
- l) All contacts for supervisory alarms and indications shall be potential free.

5.3.15 TERMINAL AND CONNECTION ARRANGEMENTS:

RATING:

Current rating shall be 1.5 times the rated current of the transformer.

OUTDOOR BUSHINGS:

- a) Bushings shall be robust and designed for adequate cantilever strength to meet the requirement of seismic condition, substation layout and movement along with the spare transformer with bushing erected and provided with proper support from one foundation to another foundation within the substation area. The electrical and mechanical characteristics of bushings shall be in accordance with IEC: 60137/DIN 42530. All details of bushing shall be submitted for approval and design review. Bushings must have been type tested successfully as per IS: 2099/IEC-60137. The type test report need to be furnished during approval stage.
- b) Bushing for voltage of 52kV and above shall be RIP bushing with composite polymer insulator. 36kV bushing shall be solid porcelain or oil communicating type.
- c) RIP type bushing shall be provided with tap for capacitance and tan delta test. Test taps relying on pressure contacts against the outer earth layer of the bushing is not acceptable.
- d) Where current transformers are specified, the bushings shall be removable without disturbing the current transformers.
- e) Bushings of identical rating shall be interchangeable to optimize the requirement of spares.
- f) Porcelain used in bushing manufacture shall be homogenous, free from laminations, cavities and other flaws or imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vitrified, tough and impervious to moisture.

g) Composite polymer insulator shall be seamless sheath of a silicone rubber compound. The housing & weather sheds should have silicon content of minimum 30% weight. It should protect the bushing against environmental influences, external pollution and humidity. The interface between the housing and the core must be uniform and without voids. The strength of the bond shall be greater than the tearing strength of the polymer. The manufacturer shall follow non-destructive technique (N.D.T) to check the quality of jointing of the housing interface with the core. The technique being followed with detailed procedure and sampling shall be decided during finalization of QAP.

The weather sheds of the insulators shall be of alternate shed profile as per IEC 60815-3. The weather sheds shall be vulcanized to the sheath (extrusion process) or moulded as part of the sheath (injection moulding process) and free from imperfections. The vulcanization for extrusion process shall be at high temperature and for injection moulding shall be at high temperature & high pressure. Any seams/ burrs protruding axially along the insulator, resulting from the injection moulding process shall be removed completely without causing any damage to the housing. The track resistance of housing and shed material shall be class 1A4.5 according to IEC60587. The strength of the weather shed to sheath interface shall be greater than the tearing strength of the polymer. The composite insulator shall be capable of high pressure washing.

End fittings shall be free from cracks, seams, shrinks, air holes and rough edges. End fittings should be effectively sealed to prevent moisture ingress effectiveness of sealing system must be supported by test documents. All surface of the metal parts shall be perfectly smooth with the projecting points or irregularities which may cause corona. All load bearing surfaces shall be smooth and uniform so as to distribute the loading stresses uniformly.

The hollow silicone composite insulators shall comply with the requirements of the IEC publications IEC 61462 and the relevant parts of IEC 62217. The design of the composite insulators shall be tested and verified according to IEC 61462 (Type & Routine test).

h) Clamps and fittings shall be hot dip galvanized/stainless steel.

i) Busing turrets shall be provided with vent pipes, to route any gas collection through the Buchholz relay.

j) No arcing horns shall be fitted to any bushing.

k) RIP bushings shall be specially packed to avoid any damage during transit & suitable for long storage with non-returnable packing wooden boxes with hinged type cover, without any gaps between wooden planks. Packing box opening cover with nails/ screws type packing arrangement shall not be acceptable. Bushing oil end portion shall be fitted with metal housing with positive dry air pressure and a suitable pressure monitoring device shall be fitted on the metal housing during storage to avoid direct contact with moisture with epoxy. Alternatively oil filled metal housing with suitable arrangement for taking care oil expansion due to temperature variations shall also be acceptable. Manufacturer shall submit drawings / documents of packing for approval during detail engineering. Detail method for storage of bushing including accessories shall be brought out in the instruction manual.

l) The terminal marking and their physical position shall be as per IEC: 60076.

m) Tan Delta measurement at variable frequency (in range of 20 Hz to 350 Hz) shall be carried out on each condenser type bushing at transformer manufacturing works as routine test before dispatch and the result shall be compared at site during commissioning to verify the healthiness of the bushing. If the bushing Tan Delta goes beyond 0.005 or increase is more than 0.001 within the guarantee period with respect to the pre-commissioning values, the contractor shall arrange to replace the defective bushing by new one. No temperature correction factor shall be applicable for Tan Delta.

TERMINAL CONNECTORS:

a) Bushing terminals shall be provided with terminal connectors of approved type and size for

connection to external parts. Terminal connectors, offered must have been successfully type tested as per IS: 5561.

- b)
- i. All castings shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be blurred and rounded off. The aluminum alloy castings, if used, shall conform to designation A6 of IS: 617.
 - ii. No part of clamp shall be less than 10 mm. Thick.
 - iii. All ferrous parts shall be hot dip galvanised conforming to IS: 2633. Spring washers and H.T. Bolts shall be electrogalvanized conforming to IS: 1573.
 - iv. For bimetallic clamp, copper alloy linear of minimum thickness of 2 mm. shall be cast integral with aluminum body.
 - v. Flexible connectors shall be made from tinned copper sheets.
 - vi. Size of terminal/conductor for which the clamp is suitable and rated current under site conditions shall be embossed/punched on each component of the clamp, except hardware.
 - vii. All current carrying parts shall be designed and manufactured to have minimum contact resistance.
 - viii. The short time rating of terminal connector shall not be less than the short time rating of respective bushing.
 - ix. Terminal connectors shall be subject to all type, routine and acceptance tests as per IS: 5561 (latest).
 - x. Malleable cast iron for terminal connectors or any of its parts and accessories shall not be acceptable.
 - xi. Bolts and Nuts used shall be of stainless steel or galvanized/passivated mild steel.

TERMINAL MARKING:

Transformer terminals are to be provided with phase markings to the requirements of IEC - 616 and are subject to the agreement of the owner. Transformer terminals shall be silver/tin - plated copper.

NEUTRAL EARTHING:

The neutral terminals shall be brought to ground level by a brass or tinned copper grounding bar of approved size which shall be supported from the tank with porcelain insulators and Connected to owner's local earth grid, the supplier must liaise with the owner or its approved contractor to finalise the details of installation of this earthing and mounting of the outdoor neutral CT on this.

5.3.16 SPECIFICATION FOR CONTROL CABINETS:

- a) Control cabinets shall be of the free standing floor mounting type.
- b) Control cabinet of the operating mechanism shall be made out of 3 mm thick sheet steel or 10 mm thick aluminium plate or casting. Hinged door shall be provided with pad locking arrangement. Sloping rain hood shall be provided to cover all sides. 15 mm thick neoprene or better type of gaskets shall be provided to ensure degree of protection of at least IP-55 as per IS: 2147.
- c) Bus bars shall be of tinned copper of adequate cross -section to carry the normal current without exceeding the permissible temperature rise over an ambient temperature of 50 degree centigrade outside the cubicle. The buses shall be braced to withstand forces corresponding to short circuit current of 25KA.
- d) Motors rated 1 KW and above being controlled from the control cabinet would be suitable for operation on a 415V, 3 Phase, 50 HZ system. Fractional KW motors would be suitable for operation on a 240V, 1- Phase, 50 HZ supply system.
- e) Isolating switches shall be group operated units (3 pole for use on 3 -MCBS phase supply systems and 2 pole for single phase supply systems) quick make quick break type, capable of breaking

safely and without deterioration, the rated current of the associated circuit. Switch handle shall have provision for locking in both fully open and fully closed positions.

- f) Push button shall be rated for not less than 6 Amps. 415V A.C. or 2 Amps, 220/110V D.C. and shall be flush mounted on the cabinet door and provided with appropriate nameplates. Red, Green and Amber indicating lamps shall be flush mounted.
- g) For motors up to 5 KW, contactors shall be direct-on-line, air break, single throw type and shall be suitable for making and breaking the stalled current of the associated motor which shall be assumed equal to 6.5 times the full load current of the motor at 0.2PF. For motors above 5 KW, automatic star delta type starters shall be provided. 3 Pole contactors shall be furnished for 3 Phase motors and 2 Pole contactors for single phase motors. Reversing contactors shall be provided with electrical interlocks between forward and reverse contactors. If possible, mechanical interlocks shall also be provided. Contactors shall be suitable for uninterrupted duty and shall be of duty category class AC4 as defined in IS: 2959. The main contacts of the contactors shall be silver plated and the insulation class for the coils shall be class E or better. The dropout voltage of the contactors shall not exceed 70% of the rated voltage.
- h) Contactors shall be provided with a three element positive acting, ambient temperature compensated, time lagged, hand reset type, thermal overload relay with adjustable setting. Hand reset button shall be flush with the front door of the cabinet and suitable for resetting with starter compartment door closed.
- i) Single phase preventer relay shall be provided for 3 Phase motors to provide positive protection against single phasing.
- j) Mini starters shall be provided with no volt coils whenever required.
- k) Owner's power cables will be 1100/650 volts grade stranded aluminium conductor XLPE insulated, PVC sheathed, single steel wire armoured and PVC jacketed. All necessary cable terminating accessories such as glands, crimp type tinned copper lugs etc., for power as well as control cables shall be included in bidder's scope of supply. Suitable brass cable glands shall be provided for cable entry.
- l) Wiring for all control circuits shall be carried out with 1100/650 Volts grade PVC insulated tinned copper stranded conductors of sizes not smaller than 2.5 m successful Agency m. At least 20% spare terminal blocks for control wire termination shall be provided on each panel. The terminal blocks shall be of non-disconnecting stand type. All terminals shall be provided with ferrules, indelibly marked or numbered and these identifications shall correspond to the designations on the relevant wiring diagrams. The terminals shall be rated for adequate capacity which shall not be less than 10Amps.
- m) Separate terminal blocks shall be provided for terminating circuits of various voltage classes. CT loads shall be terminated on a separate block and shall have provision for short circuiting the CT secondary terminals.
- n) Control cabinet shall be provided with 240V, 1 Phase, 50 HZ, 20 W fluorescent light fixture and a suitably rated 240 V, 1 Phase, 5 Amps, 3 Pin socket for hand lamps.
- o) Strip heaters shall be provided inside each cabinet complete with thermostat (preferably differential type) to prevent moisture condensation. Heaters shall be controlled by suitably rated double pole miniature circuit breakers.
- p) Signal lamps, provided shall be of LED type enclosed in Bakelite body.
- q) Electric measuring instruments shall be of moving iron type. Ammeters for measuring current up to 30 Amps shall be directly connected while those for measuring above 30 Amps shall be connected through suitable CTs. Ammeters shall be provided with selector switches.
- r) Items inside the cabinet, made of organic material shall be coated with a fungus resistant varnish.

5.3.17 INSULATING OIL:-

- a) The quality of the oil, supplied with the transformer shall conform to IEC 296 (Mineral oil class 1) and IS: 335 with latest amendment, if any. The percentage of Naphthenic content in the oil will be more than 40 percent and paraffinic content will be less than 56 percent. No oil shall be

supplied or used at any stage of manufacture or test without a certificate, acceptable to the Owner that it has a PCB content of less than 2 mg/kg. No inhibitors shall be used in the oil. The oil samples will be drawn as follows: -

- (i) Prior to filling.
- (ii) Before and after heat run test.
- (iii) Before energising.

All tests as per relevant IEC & ISS shall be conducted on all samples.

- b) Sufficient quantity of oil, necessary for first filling of all tanks, coolers and radiators at the proper level along with 10% extra oil for topping up shall be supplied in non - returnable containers, suitable for outdoor storage.
- c) The supplier shall despatch the transformer, filled with oil or in an atmosphere of Nitrogen. In the former case, the Successful Agency/Transformer Manufacturer shall take care of the weight limitation on transport and handling facility at site. In the latter case, necessary arrangement shall be ensured by the supplier to take care of pressure drop of nitrogen during transit and storage till completion of oil filling during erection. A gas pressure testing valve with necessary pressure gauge and adapter valve shall be provided.
- d) The transformer shall also be fitted with an impact recorder during transportation. This impact recorder is on returnable basis.
- e) The Bidders shall ensure that the oil supplied is in accordance with the latest editions of the following specifications with amendments, if any

Sl.No:	Characteristics	Requirement	Method of test
1	Appearance	The oil shall be clear and transparent & free from suspended matter or sediments.	A representative sample of oil shall be examined in a 100mm thick layer at ambient temperature.
2	Density at 27 Deg C(max)	0.89 g/cu.cm.	IS: 1448
3	Kinematic viscosity at	27Cst.	IS: 1448 27 Deg C (max.)
4	Interfacial tension at 27 Deg C	(min.) 0.04 N/m	IS: 6104
5	Flashpoint Penskey Marten (closed) (min.)	140 Deg C	IS: 1448
6	Pour point (max.)	-6 Deg C	IS: 1448
7	Neutralization value (max.) (Total acidity).	0.03 mg KOH/g	IS: 335
8	Corrosive sulphur (In terms of classification of copper strip)	Non-Corrosive	IS: 335 (Appendix 'B')
9	Electric Strength (break down Voltage) min. a) New Unfiltered Oil	30KV (rms) if the above value is not attained, the oil shall be filtered	IS: 6792.

	b) After treatment.	60 KV (rms)	
10	Di-Electric dissipation factor (tan delta) at 90 Deg C (max.)	0.002	IS: 6262
11	Specific resistance (resistivity) a) at 90 Deg C (min.) b) at 27 Deg C (min.)	35 x 10 ¹² Ohm-cm. 1500 x 10 ¹² Ohm-cm.	IS: 6103
12	Oxidation stability. Neutralization value a) After oxidation (max.) b) Total Sludge after oxidation (max.).	0.4 mg KOH/g. 0.10% by weight	
13	Presence of Oxidation inhibitor	The oil shall not contain anti oxidant inhibitors.	IS: 335 (Appendix 'D')
14	Water content (max.)	a) Untreated and unfiltered Oil- 50 PPM. b) Before Commissioning - 10PPM	IS: 2362
15	Aging characteristics after 96 hrs. As per AS TMD/934/IS: 12177 with catalyst (Copper) a) Resistivity. (i) 27 Deg C (ii) 90 Deg C b) Tan delta at 90 Deg C c) Total acidity. d) Sludge content by weight.	2.5 x (10) ¹² Ohm-cm. 0.2 x (10) ¹² Ohm-cm. 0.2 (max.). 0.05 mg KOH/gm (max.) 0.05% (max.)	
16	a) Naphthenic content b) Paraffinic content	More than 40% Less than 56%	Spectroscopic method or any other prescribed method.

The Test certificates to conform the quality of the oil shall be submitted by the supplier. The owner at his discretion may depute his representative for witnessing the tests at the works of the supplier or its sub-vendor. The owner's representative may recommend for testing of sample oil at CPRI/ERDA including ensuring the percentage of and paraffinic content in the offered oil. The cost for such testing shall be borne by the supplier. The owner at his discretion may also get the supplied oil, tested at Govt. approved laboratory for determination of quality, naphthenic and paraffinic contents as per specification.

5.3.18 CLEANING, PAINTING AND TROPICALISATION:-

- All steel surfaces except galvanized surfaces or where otherwise specified, shall be shot blasted to remove all rust, scale and foreign matters from the surface. Oil, grease, dirt and swarf shall be thoroughly removed by emulsion cleaning. The surfaces shall then be chemically cleaned and surface treated by phosphating and dried in accordance with IS-6005 – “Code of practice for phosphating of iron and steel”. Immediately after phosphating, the surfaces shall be given two coats of high quality zinc chromate primer.
- The interior surfaces of mechanism chambers, boxes and kiosks, after preparation, cleaning

and priming shall be painted with one coat of zinc chromate primer, one coat of phenolic based undercoating, followed by two coats of phenolic based finishing paint to white colour, followed by a final coat of anti -condensation white paint of a type and make to the approval of the Owner. A minimum overall paint film thickness of 200 microns shall be maintained throughout.

- c) All steel work and metal work, after preparation and priming shall be painted with one coat zinc chromate primer, one coat of phenolic based under coating and two coats of micaceous iron oxide paint to an overall thickness of 200 microns to hard gloss finishing Light Grey Shade No. 697 of IS:5. Each successive coat of paint shall be of slightly different shade to enable inspection. The finished surface shall present a pleasing appearance free from dents or unevenness surfaces.
- d) It is the responsibility of the supplier to ensure that the quality of paints used shall withstand the tropical heat and extremes of weather conditions. The paint shall not peel - off, wrinkle, be removed by wind, storm and handling on site and the surface finish shall neither rust nor fade during the service life of the equipment.
- e) After erection at site, the interior surfaces of mechanism chambers and kiosks shall be thoroughly examined and any deteriorated or mechanically damaged surfaces of such shall be made good to the full specification, described above.
- f) After erection at site, all surfaces of steel works and metal works shall be thoroughly washed down and examined. Any deteriorated or otherwise faulty paint work shall be removed down to bare metal and made good to the full specification described above, then painted one further coat of phenolic based under coating and one coat phenolic based hard gloss finishing paint to provide an overall minimum paint film thickness of 200 microns.
- g) All paint work shall be left clean and perfect on completion of the site works.

5.3.19 BOLTS AND NUTS:-

- a) All bolts, studs, screw threads, pipe threads, bolt heads and nuts shall comply with the appropriate Indian Standards for metric threads, or the technical equivalent.
- b) Except for small wiring, current carrying terminal bolts or studs for mechanical reasons shall not be less than 6 mm in diameter.
- c) All nuts and pins shall be adequately locked.
- d) Wherever possible, bolts shall be fitted in such a manner that in the event of failure of locking resulting in the nuts working loose and falling off, the bolt will remain in position.
- e) All bolts, nuts and washers, placed in outdoor positions shall be treated to prevent corrosion, by hot dip galvanizing. Bolts and Nuts below M12 (12mm.) size shall be of stainless steel. Appropriate precautions shall be taken to prevent electrolytic action between dissimilar metals
- f) Where bolts are used on external horizontal surfaces and where water can collect, methods of preventing the ingress of moisture to the threads shall be provided.
- g) Each bolt or stud shall project at least one thread, but not more than three threads through the nut, except when otherwise approved for terminal board studs or relay stems. If bolts or nuts are placed so that they are inaccessible by means of ordinary spanners, special spanners shall be provided.
- h) The length of the screwed portion of the bolts shall be such that no screw thread may form part of a shear plane between members.
- i) Taper washers shall be provided where necessary.
- j) Protective washers of suitable material shall be provided front and back on the securing screws.

5.3.20 WIRING AND CABLING:-

- a) Cable box/sealing end shall be suitable for following types of cable.
 - (i) 415 Volt Power 1100 Volt grade PVC Insulated aluminium conductor cable

- (ii) Control. with Armour
1100 Volt grade PVC insulated 7/0.737 mm stranded copper
Conductor cable with armour
- b) Compression type cable connector shall be provided for termination of power and control cables.
- c) All controls, alarms, indicating and relaying devices, provided with the transformer shall be wired up to the terminal blocks inside the local control cabinets (both cooler and OLTC control cabinets)
- d) All devices and terminal blocks with the cooler control cabinet shall be clearly identified by symbols, corresponding to those used on applicable schematic or wiring diagrams.

5.3.21 FITTINGS:

The following fittings shall be provided with each transformer, covered in this specification.

- a) Conservator for main tank with oil filling hole and cap, vacuum application valve, vacuum equalizing valve, isolating valves, drain valve, shut off valve, magnetic oil level gauge with low level alarm contacts, dehydrating breather, with oil seal.
- b) Conservator for OLTC with drain valve, surge relay (oil flow operated), vacuum application valve, vacuum equalizing valve, magnetic type oil level gauge with low level alarm contacts, oil-level indicator and silica gel breathers.
- c) Oil preservation equipment.
- d) Pressure relief device with alarm/trip contact.
 - (i) Buchholz relay, double float/read type with isolating valves on both sides, bleeding pipe with pet cock at the end to collect gases and alarm and trip contacts (Rating 1 Amp. 220V DC) test cock, gas collection box and gas check valve at ground level.
 - (ii) Separate Oil Surge Relay with above features to be provided for OLTC chamber.
- e) Air release plug.
- f) Inspection openings and covers.
- g) Bushing with metal parts and gaskets to suit the termination arrangement.
- h) Winding temperature indicators for local and remote mounting. One RWTI with a four point selector switch shall be provided for three windings.
- i) Top Oil temperature indicators with maximum pointer along with two sets of contactors.
- j) Cover lifting eyes, transformer lifting lugs, jacking pads, towing holes and core and winding lifting lugs.
- k) Protected type mercury or alcohol in glass thermometer.
- l) Bottom and top filter valves with threaded male adaptors, bottom sampling valve and drain valve.
- m) Rating and diagram plates on transformers and auxiliary apparatus.
- n) Earthing terminals.
- o) Flanged bi-directional wheels.
- p) Cooler Control Cabinet with pad locks.
- q) On load tap changing equipment and OLTC control cabinet with pad locks.
- r) Drain valve plugs shall be provided in order that each section of pipe work can be drained independently.
- s) Insulating Oil.
- t) Terminal marking plate.
- u) Jacking pads/lugs
- v) Lifting bollards.
- w) Haulage lugs.
- x) Cover lifting lugs.
- y) Valve schedule plate.
- z) Valves, as indicated at Cl.No.5.4.2 of this specification.
- aa) Wiring up to Marshalling box with PVC SWA PVC copper cables, 1100 volts grade.
- bb) RTCC Panel
- cc) Bushing Terminal Clamps & Connectors

dd) Valves, as indicated at Cl.No.5.4.2 of this Specification

ee) Wiring up to marshalling box with PVC SWA PVC copper cables, 1100Volts grade.

Note: - The fittings listed above are only indicative and any other fittings which generally are required for satisfactory operation of the above rated power transformers are deemed to be included.

5.3.22 LIMITS OF TEMPERATURE RISE:-

The temperature rise on any part of equipment shall not exceed the maximum temperature rise specified below under the conditions specified in test clauses. The permissible temperature rise indicated is for a maximum ambient temperature of 50 degree C. If the maximum ambient temperature rises, permissible values shall be reduced accordingly. For actual maximum temperature at the location of installation, refer perfect synopsis.

Sl.No:	<u>Nature of the part or of the liquid.</u>	<u>Maximum value of:</u>	
		<u>Temperature.</u>	<u>Temperature rise at a maximum ambient air temp. not exceeding 50 degree C.</u>
1	Contacts in air, silver-faced copper, copper alloy or aluminium alloy (see notes (i) & (ii).	95	40/45
	Bare copper or tinned aluminium alloy.	75	25
2	Contacts in oil:	90	40
	Silver-faced copper, copper alloy or Aluminium alloy [see note-(i)].	80	30
3	Terminals to be connected to external conductors by screws or bolts silver Faced (see note (iii)).	105	55
4	Metal parts acting as springs.	(See note iv).	(See note iv).
5	Metal parts in contact with insulation of the following classes:		
	Class Y : (for non-impregnated Materials).	90	40
	Class A: (for materials immersed in oil	100	50
	Or impregnated.	120	70
	Class E: in air	100	50
	In oil	130	80
	Class B: in air	100	50
In oil	155	105	
		100	50

	Class F: in air	100	50
	In oil	120	70
	Enamel: oil base	100	50
	Synthetic, in air		
	Synthetic, in oil		
6	Any part of metal or of insulating Material in contact with coil, except contacts.	100	50
7	Oil	90	40

Notes:

- (i) When applying the temperature rise of 45° C, care should be taken to ensure that no damage is caused to the surrounding insulating materials.
- (ii) The quality of the silver facing shall be such that a layer of silver remains at the points of contact after the mechanical endurance test. Otherwise, the contacts
- (iii) The values of temperature and temperature rise are valid whether or not the conductor connected to the terminals is silver-faced.
- (iv) The temperature shall not reach a value where the elasticity of the material is impaired. For pure copper, this implies a temperature limit of 75°C.

5.3.23 MOTORS & MCBS:

- a) All motors shall comply with IS: 325 and IEC 34 and dimensions with IEC-72. They shall be capable of operating continuously under actual service conditions without exceeding the specified temperature rises, determined by resistance, at any frequency between the voltage and frequency fluctuation, stated in this specification.
- b) All miniature circuit breakers shall be provided with auxiliary contacts for remote indication of circuit breaker operation. Means shall be provided to prevent the miniature circuit breakers, being inadvertently switched to the 'OFF' Position. Miniature Circuit breakers shall be mounted in such a manner so as to give easily visible indication of breaker position and shall be grouped and spaced according to their function in order to facilitate identification and easy replacement.

5.3.24 LIST OF MANDATORY SPARES:

The supplier shall provide the mandatory spares, detailed below and shall, where considered necessary, provide a list of recommended spare parts together with their individual prices. The owner may order all or any of the spare parts, listed at the time of contract award and the spare parts, so required by the owner, shall be supplied as part of this contract. Additional spares may be ordered at any time during the contract at the rates, stated in the purchase Order.

Sr. No.	Description.	Quantity.
1	245kV HV RIP Bushing with metal parts & gaskets	2 No
2	36kV LV Bushing with metal parts & gaskets	1 No
3	52kV HV RIP Neutral Bushing with metal parts & gaskets	1 No
4	36kV LV Neutral Bushing with metal parts & gaskets	1 No
5	Winding Temperature indicators with contacts	1 set
6	Oil Temperature indicators with contacts	1set
7	Pressure Relief Device	1 No
8	Magnetic oil level gauge with low oil level alarm contacts	1 No
9	Cooler fan with motor	1 No
10	Buchholz relay	1 No

11	Tap position Indicator	1 No
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N.B.:-

- a) The Supplier shall ensure that sufficient spare parts and consumable items are available for his own use during commissioning of the transformer. The spares, provided with the transformer shall not be used by the supplier without the written consent of the Owner and any spares, used during the commissioning of the transformer shall be replaced by the supplier at his own expense.
- b) The Supplier shall provide a list in the schedule, of additional recommended spare parts together with their individual prices. The Owner may order at a later date, at a price, indicated on the schedule, such additional spare parts, listed at the time of contract award.
- c) Spares shall be available during the life of the equipment and the Supplier shall give 12 months' notice of his or any Sub-Suppliers, intention to cease manufacture of any component used in the equipment.
- d) Any spare apparatus, parts and tools shall be subject to the same Specification, tests and conditions as similar material, supplied under this contract. They shall be strictly interchangeable and suitable for use in place of the corresponding parts, supplied with the transformer and must be suitably marked and numbered for identification and prepared for storage by greasing and painting to prevent deterioration.
- e) All spare apparatus or materials, containing electrical insulation shall be packed and delivered in cases, suitable for storing such parts or material over a period of years without deterioration. Such cases shall have to be affixed to both the underside and topside of the lid a list detailing its contents. The case will remain as the property of the Owner.

5.3.25 NITROGEN INJECTION FIRE PROTECTION SYSTEM:

a) GENERAL:

~~Nitrogen Injection system for 20 MVA 220/33kV Power Transformers shall be provided for protection against transformer explosion.~~

b) NITROGEN INJECTION SYSTEM:

~~Transformer shall be provided with a dedicated Nitrogen Injection system for prevention against the transformer explosion which shall use nitrogen as quenching medium. The system shall prevent Transformer oil tank explosion and possible fire in case of internal / external cause. In the event of fire by external causes such as bushing fire, OLTC fires, fire from surrounding equipment etc., it shall act as a fast and effective fire fighter. It shall accomplish its role as fire preventer and extinguisher without employing water or carbon dioxide. Fire shall be extinguished within reasonable with time (not more than 3 minutes so as not to harm the transformer) of system activation and within 30 seconds (maximum) of commencement of nitrogen injection.~~

Activation of the system:

~~Mal functioning of the Nitrogen injection system could lead to interruption in power supply. The supplier shall ensure that the probabilities of chances of malfunctioning of the Nitrogen injection system are practically zero. To achieve this objective, the supplier shall plan out scheme of activating signals which should not be too complicated to make the system inoperative in case of actual need. The system shall be provided with automatic controls to prevent the explosion of transformers. Besides automatic control, remote electrical push button control at Control box and local manual control in the cubicle shall also be provided. The following electrical signals shall be used for activating the system under prevention mode/fire extinguishing mode.~~

General description:

Nitrogen Injection system should be a dedicated system for each oil filled transformer. It should have a Fire Extinguishing Cubicle (FEC) placed on a plinth at a distance of 5-10 m away from transformer or placed next to the firewall (if fire fighting wall exists). The FEC shall be connected to the top of transformer / reactor oil tank for depressurization of tank and to the oil pit (capacity is approximately equal to 10% of total volume of oil in transformer or existing oil pit) from its bottom through oil pipes. The FEC should house a pressurized nitrogen cylinder (s) which is connected to the oil tank of transformer / reactor oil tank at bottom. The Transformer Conservator Isolation Valve (TCIV) is fitted between the conservator tank and Buchholz relay. Cable connections are to be provided from signal box to the control box in the control room, from control box to FEC and from TCIV to signal box. Detectors placed on the top of transformer / reactor tank are to be connected in parallel to the signal box by Fire survival cables. Control box is also to be connected to relay panel in control room for receiving system activation signals.

Operation:

On receipt of all activating signals, the system shall drain — predetermined volume of hot oil from the top of tank (i.e. top oil layer), through outlet valve, to reduce tank pressure by removing top oil and simultaneously injecting nitrogen gas at high pressure for stirring the oil at pre-fixed rate and thus bringing the temperature of top oil layer down. Transformer conservator isolation valve blocks the flow of oil from conservator tank in case of tank rupture / explosion or bushing bursting. Nitrogen occupies the space created by oil drained out and acts as an insulating layer over oil in the tank and thus preventing aggravation of fire.

System components:

Nitrogen Injection system shall broadly consist of the following components. However, all other components which are necessary for fast reliable and effective working of the system shall deemed to be included in the scope of supply.

1) CUBICLE (FEC):

The Cubicle Frame shall be made of CRCA sheet of 3 mm (minimum) thick complete with the base frame, painted inside and outside with post office red colour (shade 538 of IS-5). It shall have hinged / hinged split doors fitted with high quality tamper proof lock. The doors, removable covers and panels shall be gasketed all round with neoprene gaskets. The degree of protection shall be IP55. The following items shall be provided in the Cubicle.

- Nitrogen gas cylinder with regulator and falling pressure electrical contact manometer.
- Oil drain pipe with mechanical quick drain valve.
- Electro mechanical control equipment for draining of oil of predetermined volume and injecting regulated volume of nitrogen gas.
- Pressure monitoring switch for back-up protection for nitrogen release.
- Limit switches for monitoring of the system.
- Butterfly valve with flanges on the top of panel for connecting oil drain pipe and nitrogen injection pipes for transformer / reactors.
- Panel lighting (CFL Type)
- Oil drain pipe extension of suitable sizes for connecting pipes to oil pit.
- Space heater.

2) Control box:

Control box is to be placed in the control room for monitoring system operation, automatic control

and remote operation. The following alarms, indications, switches, push buttons, audio signal etc. shall be provided.

- _____ • System Oil.
- _____ • TCIV open.
- _____ • Oil drain valve closed.
- _____ • Gas inlet valve closed
- _____ • TCIV closed
- _____ • Detector trip
- _____ • Buchholz relay trip
- _____ • Oil drain valve open
- _____ • Extinction in progress
- _____ • Cylinder pressure low
- _____ • Differential relay trip
- _____ • PRV / RPRR trip
- _____ • Transformer / reactor trip
- _____ • System out of service
- _____ • Fault in cable connecting fault detector
- _____ • Fault in cable connecting differential relay
- _____ • Fault in cable connecting Buchholz relay
- _____ • Fault in cable connecting PRV / RPRR
- _____ • Fault in cable connecting transformer reactor trip
- _____ • Fault in cable connecting TCIV
- _____ • Auto / Manual / Off
- _____ • Extinction release on / off
- _____ • Lamp test
- _____ • Visual / Audio alarm for AC supply fail
- _____ • Visual / Audio alarm for DC supply fail

~~As far as possible the control box should be such devised that all the transformers should be controlled from single spot.~~

3) ~~Transformer Conservator Isolation Valve:~~

~~Transformer conservator isolation valve (TCIV) to be fitted in the conservator pipe line, between conservator and buchholz relay which shall operate for isolating the conservator during abnormal flow of oil due to rupture / explosion of tank or bursting of bushing. The valve shall not isolate conservator during normal flow of oil during filtration or filling or refilling, locking plates to be provided with handle for pad locking. It shall have proximity switch for remote alarm, indication with visual position indicator.~~

~~The TCIV should be of the best quality as malfunctioning of TCIV could lead to serious consequence. The closing of TCIV means stoppage of breathing of transformer / reactor.~~

~~Locking plates shall be provided for pad locking.~~

4) ~~Detectors:~~

~~The system shall be completing with adequate number of detectors (quartz bulb) fitted on the top cover of the transformer / reactor oil tank.~~

5) ~~Signal box:~~

~~It shall be mounted away from transformer / reactor main tank, preferably near the transformer~~

~~marshalling box, for terminating cable connections from TCIV & detectors and for further connection to be control box. The degree of protection shall be IP55.~~

~~6) Cables:~~

~~Fire survival cables (capable to withstand 750° C.) of 4 core x 1.5 sq. mm size for connection of detectors in parallel shall be used. The fire survival cable shall conform to BS 7629 1, BS 8434-1, BS 7629 1 and BS 5839 1, BS EN 50267 2 1 or relevant Indian standards.~~

~~Fire Retardant Low Smoke(FRLS) cable of adequate size shall be used for connection of signal box / marshalling box near transformer / reactor and FEC mounted near transformer/ reactor with control box mounted in control room.~~

~~Fire Retardant Low Smoke (FRLS) cable of 4 core x 1.5 sq. mm size shall be used for connection between control box to DC & AC supply source, FEC to AC supply source, signal box / marshalling box to transformer conservator isolation valve connection on transformer / reactor. Separate cables for AC supply & DC supply shall be used.~~

~~7) Pipes:~~

~~Pipes complete with connections, flanges, bends and tees etc. shall be supplied along with the system.~~

~~8) Other items to be supplied:~~

- ~~(a) Oil drain and nitrogen injection openings with gate valves on transformer / reactor tank at suitable locations.~~
- ~~(b) Flanges between Buchholz relay and conservator tank for fixing TCIV.~~
- ~~(c) Detector brackets on transformer / reactor tank top cover.~~
- ~~(d) Spare potential free contacts activating the system i.e. in differential relay, Bucholz relay. Pressure Relief Device / RPRR, Circuit breaker of transformer / reactor.~~
- ~~(e) Pipe connections between transformer / reactor and FEC and between FEC and oil pit required for collecting top oil.~~
- ~~(f) Cabling for detectors mounted on transformer / reactor top cover.~~
- ~~(g) Inter cabling between signal box, control box and FEC.~~
- ~~(h) Butterfly valves / Gate valves on oil drain pipe and nitrogen injection pipe which should be able to withstand full vacuum.~~
- ~~(i) Supports, signal box etc. which are to be painted with enameled paint.~~
- ~~(j) Any other item required for satisfactory operation of system.~~

Power supply:

- ~~For Control Box 220 V DC~~
- ~~For FEC Auxiliary 230 V AC~~

Spares for three (3) years Operation & Maintenance:

~~The bidder apart from the below mentioned spares shall submit a list of recommendation spares for three years trouble free operation of the equipments and also furnish unit rates. The owners will scrutinize the said list and decide on the items on spares to be ordered and the quantities. These spares shall be supplied by the contractor before end of guarantee period. The owner reserves right to order the spares with twelve (12) months from the date of order for main equipments and the rate shall be kept valid till this date. The prices of these spares shall not be considered for evaluation of the bid.~~

Mandatory Spares:

- Cylinder filled with Nitrogen of required Capacity per substation. — 1 No.
- Detectors per transformer — 3 No.
- Regulator assembly per sub station — 1 No.

Auto Mode:

-For prevention:

- Differential relay operation.
- Buchholz relay paralleled with pressure relief valve or RPRR (Rapid Pressure Rise Relay)
- Tripping of all circuit breakers (on HV & LV side) associated transformer is the pre-requisite for activation of system.

For extinguishing:

- Fire Detector
- Buchholz relay paralleled with pressure relief valve or RPRR (Rapid Pressure Rise Relay).
- Tripping of all circuit breakers (on HV & LV side) associated with transformer is the pre-requisite for activation of system.
- a) Manual Mode (Local / Remote):
Tripping of all circuit breakers (on HV & LV side) associated with transformer / reactor is the pre-requisite for activation of system.
- b) Manual Mode (Mechanical):
 - Tripping of all circuit breakers (on HV & LV side) associated with transformer / reactor is the pre-requisite for activation of system.

The system shall be designed to be operated manually in case of failure of power supply to the system.

Interlocks:

-It shall be ensured that once the NIFPES gets activated manually or in auto mode, all the connected breakers shall not close until the system is actually put in OFF mode. Also PRV shall get closed only if all the connected breakers are open.

Tests:

Contractor has to carry out the type test as per relevant IS/IEC. Specifically IP-55 on FEC or have to produce the report from NABL approved Lab.

Reports of all routine test conducted as per relevant IS/IEC standards in respect of various bought out items including test reports for degree of protection for FEC / control box / signal box shall be submitted by the supplier.

-The supplier shall demonstrate all the functional test associated with the following as Factory Acceptance Tests:

- FEC, Control Box
- Fire Detector
- Transformer Conservator Isolation Valve

-The performance test of the complete system shall be carried out after erection of the system with transformer at site.

~~Detailed layout drawings, equipment drawing along with 4 sets of Operation and Maintenance manual along with soft copies (In CDs) shall be submitted by the supplier along with the consignment.~~

~~The guaranteed and other technical particulars for the offered system are indicated in Section "Guaranteed and Other Technical Particulars".~~

6.0 INSPECTION AND TESTING:-

6.1 TESTING FACILITIES:-

Successful Agency shall submit along during detailed engineering, the details of testing facilities, available at proposed Transformer Manufacturer's works for carrying out all the routine and type tests, as specified.

In case, the test facilities for any particular test are not available at Transformer Manufacturer's works, this shall be clearly brought out in the additional information schedule and proposed arrangement of carrying out that test shall be clearly indicated.

All the measuring systems, used for the tests have certified, traceable accuracy and are subjected to periodic calibration, according to the rules of 4.11 of ISO 9001 [Ref - Cl.No.10 (Tests) of IEC-60076-1]

OPTCL at its discretion may use their own testing equipments or third party testing equipments such as Power Analyzer, Resistance meter etc during Routine test/Type test of the transformers at Transformer Manufacturer's works. The test results of TFL/Third party instrument will be accepted for the purpose of the contract. During testing & inspection, of the Transformer, it shall be ensured to the Inspecting Officers that there must be direct connections from the secondary of the unit auxiliary testing transformer and from the secondaries of the testing instrument transformers to the power analyzer without any termination or any other parallel connection what so ever. The measuring instruments with connections should be positioned in such a manner that there shall be easy access to the above instruments / equipments at the time of testing by Inspecting Officers

6.2 GENERAL:-

Inspection and testing shall be carried out on the transformer as detailed here and generally in accordance with IEC 76 and IS: 2026. The Owner shall have the right to reject a transformer, if test results do not comply with the standards/values, specified and information/data, given in the schedules. For the purpose of determining when type tests are required, a transformer is considered to be representative of others only if it is fully identical in design, rating and construction.

Before and after acceptance testing, samples of oil shall be taken from the transformer and analysed for dissolved gases, using the procedures, specified in IEC Publications 567 and 599. Results of the analysis of gases, dissolved in the oil shall be immediately submitted to the Owner and included in the Acceptance Test Report. On completion of acceptance testing, the Supplier shall provide the Owner with seven copies of the complete test reports.

Full details of the proposed methods of testing including connection diagrams shall be submitted by the Supplier for approval at least one month before testing. All tests will be witnessed by the Owner. The Owner shall have full access at all times to the works and all other places of manufacture of the transformers. The Supplier shall report to the Owner monthly or other period, as agreed between the two on manufacturing progress. The Supplier shall give the Owner on award of contract a complete manufacturing inspection program to allow the Owner, at its discretion, to inspect at all stages of transformer manufacture.

6.3 STAGE INSPECTION: -

Stage inspection on core, windings, tank, OLTC and all other accessories etc. will be carried out by

the supplier in the presence of OPTCL/TFL's Representative on free of cost to OPTCL/TFL before tanking of the core and windings. All the measurements will be taken on the above components, so as to ensure their compliance to the above Specification and the Guaranteed Technical Particulars. The possible routine tests like measurement of D.C. resistance, no load current and no load loss, determination of Knee Point Voltage, specific core loss, tank tests etc., will be conducted during stage inspection. For determination of number of turns in the windings, the manufacturer shall provide dummy core, so as to accommodate the LV winding and determining the ratio between the unknown No. of turns (winding) and known No. of turns, wrapped around the LV Winding. The Owner's representative at his discretion may choose small strips of core for testing at CPRI/ERDA. Also, a small piece of conductor for each type of winding and core material shall be made available to the owner's representative. Apart from the above, the owner at his discretion reserves the right to carry out the stage inspection at other stages also, for which advance intimation shall be given and all necessary co-operation shall be rendered by the manufacturer. The Supplier shall give at least three weeks' notice in advance for deputing inspecting officer(s) to their works. Type Tests and routine tests on the transformer shall be conducted only if the stage inspection report and the pre-tanking tests are found to be in order as per this Specification

The following are the stages for which inspections will be conducted with the following sequences:-

- a)** Inspection of packed core coils at the port of receipt (For those manufacturers, who do not have in house core cutting facility).
- b)** Inspection of core cutting as per core design approved by OPTCL.
- c)** Inspection of core assembly, windings, Optic fibre temperature system and tanks with corresponding tests as per specification of OPTCL.
- d)** Inspection & testing of OLTC at the vendors works, which can be done during the above 03 inspections.

6.4 FINAL INSPECTION& TESTING:-

Before offering for final inspection, type tests and routine tests, the Supplier shall furnish the factory test results (except dielectric tests) of the offered transformer(s) along with list of equipments/meters/instruments, to be used, during testing (both routine and type tests) as per Annex of this Specification along with calibration certificates of measuring instruments. The Owner may direct the Supplier for use of better equipments/meters during inspection/testing. The calibration of all the meters/instruments to be used during testing should have been done in Government approved laboratory.

6.4.1 TYPE TESTS & SPECIAL TESTS:-

The followings shall be regarded as type tests and shall be carried out in presence of Purchaser's representative at the discretion of the purchaser. The charges for conducting each type test shall be borne by the Bidder.

a) Temperature Rise Test:-

Test of temperature rise (IEC Publ. 76.2): This test shall be carried out on the tap giving the worst combination of loading on the transformer windings. The transformer shall be tested by feeding the tested losses or quoted losses, whichever is higher. The supplier, before carrying out such tests, shall submit detailed calculations, showing the alternatives possible on various taps and for the two different ratings (ONAN/ONAF) of the transformer and shall recommend the combination that results in highest temperature rise for the test. Temperature rise shall be measured at ONAN&ONAF ratings. Gas chromatographic analysis on oil shall be carried out before and after the temperature rise test and the results recorded in the test report. Sampling shall be in accordance with IEC 60567. For evaluation of the gas analysis in temperature rise test, the procedure shall be as per IS: 9434 (based on IEC: 60567) and the results will be interpreted as per IS: 10593 (based on IEC-

60599). These results shall be treated as reference during future maintenance of Transformers. The calibration of OTI and WTI shall be done by transformer manufacturer and these calibrated OTI; WTI shall be used during testing of the transformer. The Serial No. of WTI and OTI should be recorded during testing of the Transformer and only these OTI & WTI shall be supplied with the Transformer.

b) Measurement of Zero Sequence Impedance:-

Measurement of open circuit and short circuit zero sequence impedances of the primary and secondary windings.

c) Auxiliary Power Consumption:-

Measurement of power taken by fans

d) Vacuum Test:-

Transformer tank shall be subject to full vacuum and tested at an internal pressure of 3.33 KN/Sq.m (25 Torr) for one hour. The permanent deflection of plates after the vacuum has been released shall not exceed the values, specified below and the performance of the transformers shall not be affected in any way.

<u>Horizontal length of flat plate (mm)</u>	<u>Permanent deflection (mm)</u>
Up to and including 750	5.0
751 to 1250	6.5
1251 to 1750	8.0
1751 to 2000	9.5
2001 to 2250	11.0
2251 to 2500	12.5
2501 to 3000	16.0
Above 3000	19.0

e) Pressure Test:-

Transformer tank together with its radiators, conservator vessel and other fittings shall be subjected to a pressure, corresponding to twice the normal head of oil or to the normal pressure plus 35KN/Sq.m. whichever is lower. The applied pressure shall be measured at the base of the tank and maintained for one hour. The permanent deflection of flat plates after excess pressure has been released shall not exceed the values, specified in (d).

f) IP-55 Test:-

One cooler control cabinet and OLTC cabinet for each type of transformer shall be tested for IP-55 protection in accordance with IS-2147/IEC-529.

N.B.: IMPULSE TEST

- (i) The transformer offered or higher capacity (Both MVA & voltage rating) should have been tested as per the above type tests [6.4.1(a) to (f)] and chopped Lightning Impulse tests, as prescribed in this specification in presence of authorized representative(s) of Government Utilities. The successful Agency shall furnish four sets of such type & special test reports including Lightning Impulse Test Report (chopped Impulse) (indicating there in the type and design details) during detailed engineering.
- (ii) Test reports towards all type tests as per IEC-214: 1976 and BS: 4571:1970 for the offered OLTC along with approved drawings to be submitted. Owner at his discretion may insist on repetition of some or all the applicable type tests as per above IEC & BS, at supplier's cost, if any discrepancy/deviation/deficiency is noticed in the type test reports.

Dynamic Short Circuit test:- If desired by Purchaser, the 'Dynamic Short Circuit Test' shall be conducted at CPRI, Bangalore or any other Govt. Lab in India. The firm needs to quote price for above testing and transportation/other charges separately in the price bid. The firm will make all necessary arrangements for above Test. The delivery period of the said transformer shall be extended accordingly.

6.4.2 ROUTINE TESTS:-

The followings shall be regarded as routine tests and shall be conducted on each transformer in the presence of Owner's representative. No extra cost shall be paid for these tests.

- a) **Measurement of winding resistance at all taps.**
- b) **Voltage- ratio measurement and check of vector group.**
- c) **Measurement of capacitance and dielectric dissipation factor.** (Before and after the series of dielectric tests). The capacitance test shall be carried out with the help of ampere turn bridge method on fully assembled transformer (filled with oil) to determine capacitance and tan delta between winding and earth as under:
 - (i) HV winding with LV winding and tank earthed.
 - (ii) LV winding with HV winding and tank earthed.
 - (iii) HV and LV windings with tank earthed.

d) **Measurement of Insulation Resistance and Determination of Polarisation Index:-** This measurement shall be made with ten minute and one minute I R tests and should be repeated after all other tests.

e) **Impulse Test:**

- (i) **Full Wave Impulse Voltage withstand Test:** - The test voltage shall be applied to each line. The applied voltage shall be the relevant lightning impulse voltage, specified in the schedule of requirements. This test shall be applied to each HV & LV Phase terminal.
- (ii) **Chopped wave impulse voltage withstand test:** - The test voltage shall be applied to each line terminal. The applied voltage shall be 110% of the specified relevant lightning impulse voltage. This test shall be applied to each HV & LV Phase terminal.
- (iii) An impulse test on transformer neutrals as per IEC-76-3 Clause 12.3.2 shall be carried out.

Tests (i) and (ii) shall be combined in a single sequence as follows for each line terminal:-

1. One reduced full impulse (calibration).
2. One 100% full impulse.
3. One or more reduced chopped impulse(s).
4. Two 100% chopped impulses.
5. Two 100% full impulses.

The sequence for test (iii) shall be as follows:-

1. One reduced full impulse at 50-75% of full level.
2. Three 100% full impulses.

In carrying out the above tests, the two extreme taps and another tap to be selected by the owner with each of the three phases, being tested on a different tap

f) **Separate source voltage withstand test:-**

The applied voltage shall be the specified/relevant power frequency voltage.

g) **Induced over-voltage withstand test:-**

The above Test shall be carried out as per IEC-76-3. The firm shall have to submit the over-potential diagram with details of calculation and explanation along with the offer for inspection.

h) **Partial discharge test:-**

This test shall be carried out using a broad band instrument. The voltage time envelope shall be as described in clause 11.4 of IEC 76-3. The apparent charge (q) shall be in accordance with IEC 76-3.

i) **Measurement of Impedance voltage on all taps.**

j) **Measurement of the load loss at normal tap and extreme taps.** (To be carried out by three wattmeter method with low power factor at wattmeter's at full rated current). The voltage, current, wattage, power factor and frequency meter reading in individual phases (u, v, w) shall be recorded during testing and shall be reflected in the test report.

k) **Measurement of no load loss, no load current and determination of knee point voltage: -**

This test is to be carried out with three wattmeter method/Power Analyser by using low power factor wattmeter, three power factor meters, phase sequence meters, three low range ammeters and three each of average value and RMS value voltmeters. The test voltage from 10% voltage

to 125% voltage shall be applied and currents, voltages (Average value and RMS value), wattmeter, power factor and frequency meter readings in all the three phases are to be recorded during the test. A saturation characteristic curve between the no load voltage (rms) vs. Measured current is to be plotted on the graph sheet, so as to determine the voltage at which increasing voltage by 10% (ten percent), the excitation current shall not increase by more than 50% (fifty percent). The knee point voltage as per specification will be complied if the excitation current at 121% of rated no load voltage shall not exceed by not more than 50% over the excitation current, obtained at 110% of the rated no load voltage. During the no load test, Supplier's own generator set shall be used for feeding the above no load voltages at rated frequency. If the applied frequency is greater than the rated frequency, then proportionate voltage as per the rated frequency will be fed during the above no load test and following frequency correction formula along with the formula, stipulated at Clause No 16.5 of IS:2026 (Part -I) shall be used.

$$K = 0.5 [(f/f_1) + (f/f_1)^2]$$

Where f = rated frequency and f₁ = applied frequency.

For Example: - If measured loss = X Watts, correction factor due to R.M.S. and average voltage as per ISS = K₁ and frequency correction factor = K as per above formula, then corrected loss will be calculated as = measured loss*K₁*K.

N.B.:-

- 1) If power analyser is to be used for determination of no load loss, no load current, Impedance Voltage, short circuit losses etc., its manual of operation, calibration certificate and the relevant standard for its use shall be produced prior to one month of test offer for studying its feasibility and reliability.
 - 2) C.Ts. and P.Ts. of accuracy class 0.2s or better as per IS: 2705 are to be used during determination of no load losses and short circuit losses which involves financial implication. The calibration certificates of these C.Ts. & P.Ts. from independent Government approved laboratory shall be produced along with the traceability while offering for inspection. The accuracy class of reference standard C.T. & P.T. used for determination of the errors of the above C.Ts. & P.Ts. shall be 0.05 or better as per Clause No.2.9 of IS : 1248 (Part-9).
- l) Measurement of Harmonic level** (1st to 24th Harmonic) in no-load current in all three phases at 90%, 100% and 110% of no-load voltage. The magnitudes of no load currents for all the three phases at the above excitation levels shall also be recorded and reflected in the test report for measurement of harmonic levels.
- m) Measurement of capacitance and dielectric dissipation factor [Repeat © above).**
- n) Measurement of polarisation Index (Repeat (d) above).**
- o) Tests on no-load tap-changer (as per IS: 2026)**
- p) Transformer noise measurement:-**
Noise level measurement in accordance with IEC Publication 551 using a precision sound level meter conforming to IEC Publication 651.
- q) Auxiliary circuit tests:-**
All auxiliary circuits shall be subjected to application of 2KV (rms) withstand test voltage. Correct operation of all auxiliary control circuits will be tested.
- r) Core earth test:-**
A test voltage of 2KV shall be applied between the core and the earthed structural steel work to prove that the core is earthed through the removable link, at one point only.
- s) Oil BDV test.**
- t) Measurement of Neutral current** during load loss test, which shall not be more than 2% of the rated current of the transformer.
- u) Magnetic balance test.**
- v) DGA test before and after all the tests.**
- w) Oil Leakage test on transformer tank:-**
All tanks and oil-filled compartments shall be tested for oil tightness by completely filling

with oil of viscosity, not greater than that of insulating oil, conforming to IS: 335 at the ambient temperature and as per this specification and applying a pressure, equal to the normal pressure plus 35KN/Sq.m., measured at the base of the tank. This pressure shall be maintained for a period of not less than 12 hours, during which time, no leakage shall occur. successful Agency shall arrange for witnessing the leakage test of each tank.

x) Pressure Relief Device Test:-

The pressure relief device of each size shall be subjected to increasing oil pressure. It shall operate before reaching the test pressure, specified at Cl.No.5.4.4 of this specification. The operating pressure shall be recorded. The device shall seal off after the excess pressure has been relieved. The following functional checks shall be conducted as acceptance tests on each of the pressure relief devices.

- (i) Air- Pressure Test.
- (ii) Liquid Pressure Test.
- (iii) Leakage Test.
- (iv) Contact Test.
- (v) Di-electric Test.

y) Frequency Response Analysis (FRA) Test:-

The supplier shall conduct the test at the time of final testing of the transformer and record the amplitude and phase shift results on CDS for subsequent analysis. The test shall also be carried out by the supplier before commissioning at site and compare this result with the results, obtained before dispatching the transformer and submit the report along with the above results in CDs for future analysis. Each transformer is subjected to FRA test and frequency responses, recorded as above and analysed in any of the following: -

- (i) Shift in the response of the winding.
- (ii) Differences between the responses of all the phases of the transformer.

z) Dew point measurement test before dispatching:-

Positive Gas pressure is generally maintained at 0.175 Kg/m² during transportation and during storage. To ensure the same, dew point measurement shall also be carried out at site. The procedure and acceptance limits are as per CBIP Manual Pub. No.295 (2006) or latest.

Besides the above, the OLTC manufacturer shall conduct the following routine tests fully in compliance with IEC: 60214 on every unit, as given below, for which no extra cost will be payable by OPTCL.OPTCL/TFL will authorize its representative(s) for witnessing the said routine tests on any or some or all the OLTCs for the Transformers as per contract. It is the responsibility of the supplier to offer the OLTCs for following routine tests, to be conducted at the works of OLTC Manufacturer.

Sl.No.	IEC Reference	Test Description	Acceptance level
1	60214 I. No.5.3.1	Mechanical Endurance Test	Minimum 1000 operations
2	60214 Cl. No.5.3.2	Sequence Test	Switching operation with timing less than 50 m-secs.
3	60214 Cl. No.5.3.4	Pressure Test	10PSI (0.7kg/sq.cm.) for 8hours at room Temperature.
4	60214 Cl. No.5.3.4	Vacuum Test	Vacuum level, as guaranteed by manufacturer.
5	Special Test	Gas tightness Test	Helium based or any other mutually agreed method.
6	60214 Cl.	Auxiliary Circuits	Should withstand 2kV

	No.5.3.4	Insulation earth Test	relative to earth Test for 1 Minute.
7	Special Test	Contact resistance	< 2 milli- Ohms.
8	Special Test	Physical & Dimensional Checks.	As per approved drawing.

All the relevant test reports shall be submitted for OPTCL/TFL's Approval.

6.4.3 TESTS ON SITE:-

The following site tests shall be performed on all units: -

- a) General mechanical checks.
- b) Core and winding insulation tests (Earth fault check on arrival at site).
- c) Ratio and HV magnetisation current tests.
- d) Vector group check.
- e) Motors - Overload protection tests.
- f) Motor pumps and motor/fans - Direction of rotation check for correct flow.
- g) Buchholz device tests.
- h) Silica gel breather check.
- i) Temperature instrument calibration and tests.
- j) Operational tests on tap change equipment.
- k) Electric strength tests on insulating oil.
- l) Bushing tests.
- m) Impedance voltage at highest, rated and lowest voltage taps.
- n) Zero sequence impedance at rated voltage tap.
- o) DC resistance at all voltage taps.
- p) Correct operation of all C.Ts
- q) On-load tests.

7.0 TEST REPORTS:-

- a) Six (6) sets of certified test reports and oscillograms shall be submitted for approval prior to the despatch of the equipment. The equipment shall be despatched only when all the required type and routine tests have been carried out and test reports have been approved by the Owner.
- b) Each test report shall contain the following information:
 - (i) Complete identification, date, including serial number of the transformer.
 - (ii) Method of application, where applied, duration and interpretation of test results for each test.
- c) Four (4) copies of the test reports for the tests carried out on the ancillary apparatus are furnished to the Owner for approval prior to despatch.
- d) All auxiliary equipments/accessories shall be tested as per the relevant standards for the tests, as mentioned in this Specification. Test Certificates for the same shall be submitted to the Owner in four copies for scrutiny and record.

8.0 LIST OF TRANSFORMER ACCESSORIES AND TEST CERTIFICATES REQUIRED FOR THEM:-

Before offering for stage inspection of the Transformer, the supplier shall have to furnish the test certificates for the Transformer accessories, as enumerated below, wherever required.

SI. NO	ACCESSORY	REF. STANDARD	TEST CERTIFICATES REQUIRED
1)	Condenser	IS-2099	1) Appearance, construction and

	Bushing		<p>dimensional check.</p> <p>2) Test for leakage of internal filling at a pressure of 1.Kg/Cm² for 12h.</p> <p>3) Insulation resistance measurement with 2 KV Megger.</p> <p>4) Dry power frequency voltage withstand test.</p> <p>5) Dry power frequency voltage withstand test for test tap insulation.</p> <p>6) Partial discharge measurement up to 1.5UN/ 1.732KV</p> <p>7) Measurement of tan delta and capacitance.</p>
2)	Bushings.	IS-2099	<p>1) Appearance, construction and dimensional check.</p> <p>2) Insulation resistance measurement with 2 KV Megger.</p> <p>3) Dry power frequency voltage withstand test.</p>
3)	OLTC	IS-8468	<p>1) Oil tightness test for the diverter switch oil chamber at an oil pressure of 0.5 Kg/Cm² at 100 degree C for 1 h.</p> <p>2) Mechanical operation test.</p> <p>3) Operation sequence measurement.</p> <p>4) Insulation resistance measurement using 2 KV Megger.</p> <p>5) Power frequency voltage withstand test on diverter switch to earth and between even and odd contacts.</p> <p>6) Power frequency voltage withstand test on tap selector between maximum and minimum taps, between phases and supporting frames, between phases.</p> <p>7) Operation test of complete tap changer.</p> <p>8) Operation and dielectric test of driving mechanism.</p>
4)	Winding temperature indicator.		<p>1) Calibration test.</p> <p>2) Dielectric test at 2 KV for one minute.</p> <p>3) Accuracy test for indication and switch setting scales.</p> <p>4) Test for adjustability of switch setting.</p> <p>5) Test for switch rating.</p> <p>6) Measurement of temperature rise with respect to the heater coil current.</p>

5)	Oil temperature indicator.		<ol style="list-style-type: none"> 1) Calibration test. 2) Dielectric test of 2 KV for one minute. 3) Accuracy test for indication and switch Setting scales. 4) Test for adjustability of switch setting. 5) Test for switch rating.
6)	Pressure Relief valve		<ol style="list-style-type: none"> 1) Functional test with compressed air to check bursting, pressure indication, flag operation and switch operation. 2) Dielectric tests at 2 KV for one minute. 3) Switch contact testing at 5A, 240V AC.
7)	Cooling Fan	IS: 2312	<ol style="list-style-type: none"> 1) Insulation resistance measurement. 2) Dielectric test at 2 KV between winding and body for 1 minute. 3) Operation check. 4) Appearance, construction and Dimensional check.
8)	Buchholz Relay	IS: 3637	<ol style="list-style-type: none"> 1) Leak test with transformer oil at a pressure of 3 Kg. /Cm² for 30 minutes at ambient temperature for relay casing. 2) Insulation resistance measurement with 500 V Megger. 3) Dielectric test at 2 KV for 1 minute. 4) Element's Test at 1.75 Kg/cm² for 15 minute using transformer oil at ambient temperature. 5) Loss of oil and surge test. 6) Gas volume test. 7) Mechanical strength test. 8) Velocity calibration test. 9) Appearance, construction and dimensional check.
9)	Oil Level Indicators		<ol style="list-style-type: none"> 1) Test for oil levels. 2) Switch operations for low level alarm. 3) Switch contact test at 5A, 240V, A.C. 4) Dielectric tests at 2 KV for 1 minute. 5) Appearance, construction and dimensional check.
10)	Pressed steel Radiators		<ol style="list-style-type: none"> 1) Air pressure test at 2 Kg/ Cm² Under water for 15 minutes. 2) Appearance, construction and dimensional check

11)	OLTC Control Cubicle/ Cooler control Cubicle		<ol style="list-style-type: none"> 1) Appearance, construction and Dimensional check. 2) Electrical operation. 3) Insulation resistance measurement using 500 V Megger at ambient temperature. 4) Dielectric test at 2 KV for 1 minute.
12)	Current Transformer.	IS-2705	<ol style="list-style-type: none"> 1) Appearance, construction and dimensional check. 2) Polarity check. 3) Measurement of insulation resistance. 4) High voltage power frequency test. 5) Determination of ratio error and phase angle of measuring and protection CTS. 6) Determination of turn's ratio error for PS Class CTS. 7) Inter-turn insulation withstand test. 8) Excitation current characteristic test. 9) Secondary winding resistance measurement. 10) Knee-point voltage measurement for PS Class CT.

9.0 INSPECTION:-

9.1 GENERAL:-

- (i) The owner shall have access at all times to the works and all other places of manufacture where the transformer is being manufactured and the supplier shall provide all facilities for unrestricted inspection of the Supplier's works, raw materials, manufacture of all the accessories and for conducting necessary tests, as detailed herein.
- (ii) The supplier shall keep the owner informed in advance of the time of starting and of the progress of the manufacture of the equipment in its various stages so that arrangements could be made for inspection.
- (iii) No material shall be despatched from its point of manufacture unless the material has been satisfactorily inspected and tested.
- (iv) The acceptance of the equipment shall in no way relieve the supplier of his responsibility for meeting all the requirements of this specification and shall not prevent subsequent rejection of such equipment, if found to be defective later.

9.2 INSPECTION PROGRAMME:-

- (a) The supplier shall chalk out a detailed inspection and testing programme for manufacturing activities for the various components. An indicative programme of inspection as envisaged by the purchase is given below. This is not however intended to form a comprehensive programme, as it is supplier's responsibility to draw up and carry out such a programme, duly approved by the Owner. Stage inspection on core and winding will be carried out before tanking of core. For this, the supplier shall give at least three weeks' notice in advance. **The owner reserves the right to carry out the stage inspection, final inspection &**

testing by a third party.

- (b) Additional tests, if required, are deemed to be included in the scope of work.
- (c) Stages of inspection and owner's participation would be defined and tied up at the time of award of contract within 15 days of issue of the Purchase order.
- (d) The supplier shall arrange all his tests in such a fashion that the inspection and testing shall not exceed 5 (five) days for the above transformer.
- (e) On site testing, if any discrepancies will occur, the supplier will be asked immediately for its rectification and the supplier shall depute his representative for rectification without any delay.
- (f) At the time of final inspection, the supplier shall identify each & every item/accessories of the particular Transformer under testing. Unless all items are identified, the manufactures will not be treated as complete. Serial No. of bushings, Tap -changer, WTI, OTI and other details shall be entered into the Test reports to ensure that these items are not being applied to the subsequent Transformer units while testing. Various tests as per the specification shall be performed in the presence of OPTCL/TFL Engineers or when the inspection waiver has been given, in such a case, the testing as per the specification shall be done at the manufacturers works and same should be confirmed by documentary evidence by way of Test Certificate, which shall be got approved by OPTCL/TFL.
- (g) In case, for any reason(s), inspection is not completed or the equipment is not found to be complete with all accessories as per confirmation, given with the inspection call, the owner reserves the right to recover the complete cost of deputation of inspection team to the works of the manufacturer.
- (h) The supplier shall submit the test certificates of the bought-out items and Raw materials at the time of the routine testing of the fully assembled equipments.
- (i) It may be noted that "No change in any accessory or associated equipment after passing all the tests successfully shall be allowed and if this is subsequently detected, it shall be binding on the supplier to replace with the same item with which the initial tests were conducted at his works, failing which the entire test shall become null & void. The owner at his discretion may consider for rejection of the units, thus supplied. The entire cost for replacement of such rejected units, thus supplied and for repeating acceptance tests shall be borne by the suppliers.

TANK AND CONSERVATOR:-

- (a) Certification of chemical analysis and material test of plates.
- (b) Welder's qualification and welding procedure.
- (c) Testing of electrodes for quality of base materials and coatings.
- (d) Inspection of major weld preparation.
- (e) Crack detection of major strength weld seams by dye penetration test.
- (f) Measurement of film thickness of:
 - (i) Oil insoluble varnish.
 - (ii) Zinc chromate paint.
 - (iii) Finished coat.
- (g) Check correct dimensions between wheels, demonstrate turning of wheels through 90 degree and further dimensional check.
- (h) Check for physical properties of materials for lifting lugs, jacking pads etc. All load bearing welds including lifting lug welds shall be subjected to N.D.T.
- (i) Leakage test of the conservator.
- (j) Certification of all test results.

CORE:

- (a) Sample testing of core material for checking specific loss, bend properties, magnetisation characteristics and thickness.
- (b) Check on quality of varnish, if used on the stampings.
 - (i) Measurement of thickness and hardness of varnish on stamping.
 - (ii) Solvent resistance test to check that varnish does not react in hot oil.
 - (iii) Check overall quality of varnish by sampling to ensure uniform shining colour, no bare spot,

no over-burnt varnish layer and no bubbles on varnished surface.

- (c) Check on the amount of burrs.
- (d) Bow-check on stampings.
- (e) Check for overlapping of stampings, corners of the sheets are to be apart.
- (f) Visual and dimensional check during assembly stage.
- (g) Check for inter laminar insulation between core sections, before and after pressing.
- (h) Check on completed core for measurement of iron loss, determination of knee point voltage and check for any hot spot by exciting the core so as to induce the designed value of the flux density in the core.
- (i) Visual and dimensional checks for straightness and roundness of core, thickness of limbs and suitability of clamps.
- (j) High voltage test (2 KV for one minute) between core, its bolts and clamps.
- (k) Certification of all test result.

INSULATING MATERIAL:

- (a) Sampling check for physical properties of materials.
- (b) Check for dielectric strength.
- (c) Visual and dimensional checks.
- (d) Check for the reaction of hot oil on insulating materials.
- (e) Dimensional stability test at high temperature for insulating materials.
- (f) Tracking resistance tests on insulating materials.
- (g) Certification of all test results.

WINDING:

- (a) Sample check on winding conductor for mechanical properties and electrical conductivity.
- (b) Check insulating distance between high voltage connection, cables and earth and other live parts.
- (c) Check insulating distance between low voltage connection and earth and other parts.
- (d) Check for proper cleanliness and absence of dust.
- (e) Visual dimensional checks on conductor for scratches, dent marks etc.
- (f) Sample check on insulating paper for PH value, electric strength.
- (g) Check for the bonding of insulating paper on the conductor.
- (h) Check for absence of short circuit between parallel strands.
- (i) Check for brazed joints wherever applicable.
- (j) Measurement of voltage ratio to be carried out when core/yoke is completely restacked and all connections are ready.
- (k) Certification of all test results.

CHECKS BEFORE DRYING PROCESS:-

- (a) Check condition of insulation on the conductor and between the windings.
- (b) Check insulating distances between high voltage connections, cables and earth and other live parts.
- (c) Check insulating distances between the low voltage connection and earth and other parts.
- (d) Insulation test of core earthing. Insulation of the core shall be tested at 2 KV/min. between core to clamp plates and core bolts.
- (e) Check for proper cleanliness and absence of dust etc.
- (f) Certification of all test results.

CHECKS DURING DRYING PROCESS:

- (a) Measurement and recording of temperature, vacuum and drying time during vacuum treatment.
- (b) Check for completeness of drying by measuring IR value and TAN DELTA.
- (c) Certification of all test results.

ASSEMBLED TRANSFORMER:

- (a) Check completed transformer against approved out line drawings, provision for all fittings finish level etc.
- (b) Jack test with oil on the assembled transformers.

(c) DP test shall be carried out after jacking test.

OIL:

Site test shall be performed on oil samples before and after filling in the transformer. Oil parameters shall conform to relevant IEC & IS prior to filling at site and oil samples taken from the tank top, bottom and cooling system after filling shall possess characteristics as per above standards. The supplier shall warrant that oil furnished is in accordance with the relevant clause of this specification. The owner at his discretion may send oil sample(s) to Govt. approved laboratory for determination of quality of oil including confirmation on percentages of naphthenic and paraffinic content, as specified at Cl. No.5.4.17 (a) of this Specification.

The Successful Agency shall furnish all technical details of the bought out items for approval by owner before procurement. The supplier shall also prepare comprehensive inspection and testing programme for all bought-out/sub-contracted items and shall submit the same to the owner for approval. Such programme shall include the following components.

- (a) Buchholz Relay.
- (b) Axles and wheels.
- (c) Winding temperature indicators for local and remote mounting.
- (d) Oil temperature indicators.
- (e) Bushings.
- (f) Neutral current transformers.
- (g) Cooler control cabinet.
- (h) Cooling equipments.
- (i) Fans/Air blowers.
- (j) Tap changing switch.
- (k) Terminal connectors.
- (l) Transformer oil

9.3 PRE-SHIPMENT CHECK AT SUPPLIER'S WORKS:

- (a) Check for proper packing and preservation of accessories like radiators, Bushings, explosion vent, dehydrating breather, rollers, Buchholz relay, fan s, control cubicle, connecting pipes, conservator etc.
- (b) Check for proper provision of bracing to arrest the movement of core and winding assembly inside the tank.
- (c) Gas tightness test to conform tightness
- (d) Deviation of leakage rate and ensure adequate reserve gas capacity.

9.4 RECOMMENDED COMMISSIONING CHECKS:

- (a) Check the colour of silica gel breather.
- (b) Check the oil level in the breather housing, conservator tanks, cooling system, condenser bushing etc.
- (c) Check the bushing for conformity of connection to the lines etc. and tan delta test for bushings at 10 KV (min.)
- (d) Check for correct operation of all protection and alarm.
 - (i) Buchholz Relay.
 - (ii) Excessive winding temperature.
 - (iii) Excessive oil temperature.
 - (iv) Low oil flow.
 - (v) Low oil level indication.
 - (vi) Fan and pump failure protection.
- (e) Check for the adequate protection of the electric circuit supplying the accessories.
- (f) Check resistance of all windings on all the taps.
- (g) Insulation resistance measurement of:
 - (i) Control wiring.

- (ii) Tap changer motor and control.
- (iii) Cooling system motor and control.
- (iv) Main windings.
- (h) Check for cleanliness of the transformer and the surroundings.
- (i) Continuously observe the transformer operation at no load for 24 hours.
- (j) Gradually put the transformer on load, check and measure increase in temperature in relation to the load and check the operation with respect to temperature rise, noise level etc.
- (k) Phase sequence and vector group test.
- (l) Ratio tests on all taps.
- (m) Magnetising current test.
- (n) Tan delta measurement of windings.

11.0 QUALITY ASSURANCE PLAN:

The Successful Agency shall invariably furnish following information after issuance of Contract;

- (i) Statement giving list of important raw materials, names of Sub-suppliers for the raw materials, list of standards according to which the raw materials are tested, list of tests normally carried out on raw material in presence of Transformer Manufacturer / Bidder's representative, copies of test certification.
- (ii) Information and copies of test certificates as in (i) above in respect of bought out items.
- (iii) List of manufacturing facilities available.
- (iv) Level of automation achieved and list of areas where manual processing exists.
- (v) List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspection.
- (vi) Special features provided in the equipment to make it maintenance free.
- (vii) List of testing equipments available with the Transformer Manufacturer for final testing of equipment specified and test plant limitation, if any, vis-à-vis the type, special, acceptance and routine tests specified in the relevant standards. These limitations shall be very clearly brought out in 'Schedule of Deviations'.

The supplier shall within 30 days of placement of order, submit the following information to the owner.

- (i) Name of the raw materials as well as bought-out accessories and the names of sub-suppliers selected from those furnished along-with the offer.
- (ii) Type test certificates of the raw material and bought out accessories.
- (iii) Quality Assurance Plan (QAP) with hold points for Owner's inspection. The QAP and hold points shall be discussed between the owner and the supplier before the QAP is finalised. The QAP shall include all the quality checks as stipulated in this specification.

The supplier shall submit the routine test certificates of bought out items and raw material at the time of routine testing of the fully assembled transformer.

11.0 DOCUMENTATION:

All drawings shall conform to relevant International Standards Organisation (ISO) specification. All drawing shall be in ink and suitable for micro filming. All dimensions and data shall be in S.I. Units. **All the drawings are to be submitted in AutoCAD format in addition to hard copy in PDF format.**

The successful Agency shall furnish along during detailed engineering the dimensional drawings of transformer and all other accessories. These drawing shall include the following information.

- (a) Dimensions.
- (b) Tolerances on dimensions.
- (c) Material designation used for different components with reference to standards.

- (d) Fabrication details such as welds, finishes and coatings.
- (e) Catalogue or part members for each component and the total assembly with bill of materials.
- (f) Identification marking.
- (g) Weight of individual components and total assembled weight.

All drawing / documents as stated below & design documents in complete shape (not in a piece-meal manner) as per specification and without any deviation should be submitted within 15(Fifteen) days of placement of order to the office of CGM(E&Q). The design engineer of the firm should remain present during design review & approval.

- (a) Outline dimensional drawings of transformer and accessories.
- (b) Table of fittings for OGA.
- (c) Combined Rating and Diagram plate.
- (d) OIP HV Bushing.
- (e) LV Bushing.
- (f) Neutral Bushings.
- (g) Twin Bi-directional Roller.
- (h) Valve schedule plate
- (i) Foundation plan along with weights of foundations.
- (j) Oil filling Instruction plate.
- (k) Schematic control and wiring diagram for all auxiliary equipments including OLTC cooler control etc.
- (l) GA of Marshalling Kiosk.
- (m) General Arrangement of RTCC panel.
- (n) Assembly of core with details of stacks dimensions and weights etc.
- (o) Details of winding arrangement, conductor cross-section & weights etc.
- (p) CT rating plate.
- (q) Schematic diagram showing the flow of oil in the cooling system as well as each limb and winding Longitudinal and cross-sectional view showing the duct sizes, cooling pipes etc. for the transformer/ heat exchanger, drawn to scale shall be furnished.
- (r) Inter connection-cabbling diagram between transformer and all panels.
- (s) Constructional details and sectional views of on -Load Tap Changer.
- (t) Complete bill of materials.
- (u) Detailed dimensions, assembly and description of auxiliaries.
- (v) Constructional details of tank including material, dimensions thickness, reinforcing members, used, if any.
- (w) Galvanising and painting procedure.
- (x) Factory Test procedures, lay-out of testing equipments/circuits and Test schedules for tests.
- (y) Commissioning test procedure and report.
- (z) Operation and Maintenance Manual.
- (aa) QAP during manufacturing and during erection of the transformer.
- (bb) Any other drawings(s) as required by the owner.

NB:- If there is any deviation/deficiencies/discrepancies in the submitted drawings, the delay in revision of drawings shall be to the account of the bidder.

The purchaser shall communicate his comments/ approval on the drawings/documents to the supplier within reasonable period. The supplier shall, if necessary, modify the drawings and resubmit four copies of the modified drawings for purchaser's approval within one week from the date of comments. After receipt of purchaser's approval the bidder shall, within one week, submit 15 prints and one good quality reproducible of the approved drawings for purchaser's use.

TEST REPORTS:

- (i) Four copies of type test reports shall be furnished to the owner. One copy will be returned duly certified by the owner to the supplier.
- (ii) Four copies of routine test reports shall be furnished to the owner. One copy will be returned duly certified by the owner and only thereafter shall the materials be despatched.
- (iii) All records of routine test reports shall be maintained by the supplier at his works for periodic inspection by the owner.
- (iv) All test reports for tests conducted during manufacture shall be maintained by the supplier. These shall be produced for verification as and when requested for by the owner.

DESIGN REVIEW:-

The Transformers shall be designed, manufactured and tested in accordance with the best International Engineering Practices under strict Quality Control to meet the requirements, stipulated in the Technical specification. Adequate safety margin with respect to thermal, mechanical, dielectric, electrical stresses and electrical clearances shall be maintained during design, selection of raw materials, manufacturing process etc. so that the Transformer provides long life with least maintenance.

The design review will commence after placement of award with successful Bidder and shall be finalized before final drawing approval. The supplier shall depute their design engineer(s) to OPTCL for design review and finalisation of drawings. However, the entire responsibility of design shall rest with the manufacturer.

The representative of the purchaser may visit to the manufacturer's works to inspect design, manufacturing and testing facilities.

The design review shall be conducted generally following the "Guidelines for conducting design reviews, prepared by CIGRE SC12 working Group 12.22 and as per Appendix-VI (Design Review parameters) of CBIP Publication No – 317.

The manufacturer shall provide all necessary informations and calculations during design review to demonstrate that the Transformer meets the requirements for short circuit strength and durability. The latest recommendations of IEC and CIGRE SC12 shall be applied for short circuit withstand evaluation.

The manufacturer will be required to demonstrate the use of adequate safety margin for thermal, mechanical, dielectric and vibration etc. to take into account the uncertainties of his design and manufacturing processes.

The scope of such a design review shall at least include the followings:-

- i) Core design
- ii) Winding, tapping and Insulation design
- iii) Short-circuit withstand capability
- iv) Electrical clearances between windings to core(both axially and radially) between windings, outer windings to tank etc.
- v) Thermal design including areas, prone to hot spots including thermal modeling for placement of the Optic Fiber Temperature Sensors.
- vi) Cooler design
- vii) Over-load capacity
- viii) Over-fluxing
- ix) Magnetising Inrush current

- x) Eddy current losses
- xi) Seismic design
- xii) Insulation co-ordination
- xiii) Tank & Accessories
- xiv) Bushings & barrier design
- xv) Tap-changer
- xvi) Protective devices
- xvii) Fans & radiators
- xviii) Oil & oil preservation system
- xix) Corrosion protection
- xx) Electrical and physical interfaces with sub-station
- xxi) Earthing
- xxii) Processing and assembly
- xxiii) Testing capabilities
- xxiv) Inspection and Test plan
- xxv) Transport and storage
- xxvi) Sensitivity of design to specified parameters
- xxvii) Accoustic noise
- xxviii) Spares, inter-changeability and standardization
- xxix) Maintainability
- xxx) Any other design aspect, as deemed necessary

The supplier shall also furnish two copies of bound manuals for each transformer covering erection, commissioning, operation and maintenance instructions and all relevant informations and drawings pertaining to the main equipment as well as auxiliary devices. Marked erection drawings shall identify the component parts of the equipment as shipped to enable purchaser to carry out erection with his own personnel. Each manual shall also contain one set of all the approved drawings, type test reports as well as acceptance reports of the corresponding consignment despatched.

The manufacturing of the equipment shall be strictly in accordance with this Specification, approved drawings and no deviation shall be permitted without the written approval of the purchaser. All manufacturing and fabrication work in connection the equipment prior to the approval of the drawings shall be at the supplier's risk.

However, approval of the drawings by the purchaser shall not relieve the supplier of his responsibility and liability for ensuring correctness and correct interpretation of the latest revision of applicable standards, rules and codes of practices. The Transformer shall conform in all respects to high standards of engineering, design, workmanship and latest revisions of relevant standards at the time of ordering and the purchaser shall have the power to reject any material, which in his judgement is not in full accordance therewith.

TEST REPORTS:

- (i) Two copies of type test reports shall be furnished to the purchaser. One copy will be returned duly certified by the purchaser to the supplier.
- (ii) Two copies of routine test reports shall be furnished to the purchaser. One copy will be returned duly certified by the purchaser and only thereafter shall the materials be despatched.
- (iii) All records of routine test reports shall be maintained by the supplier at his works for periodic inspection by the purchaser.
- (iv) All test reports for tests conducted during manufacture shall be maintained by the supplier. These shall be produced for verification as and when requested for by the purchaser.

12.0 TRANSPORTATION, PACKING AND FORWARDING:-

The supplier shall dispatch the transformer, filled with oil or in an atmosphere of nitrogen or dry air at positive pressure. In the former case, the supplier shall take care of the weight limitation on transport and handling facility at site. In the latter case, necessary arrangement shall be ensured by the supplier to take care of pressure drop of nitrogen or dry air during transit and at site of installation. The nitrogen or dry air cylinder, provided to maintain positive pressure can be taken back by the supplier after oil filling. A gas pressure-testing valve with necessary pressure gauge and adapter valve shall be provided. Transformer shall also be fitted with at least one “Electronic impact Recorder” (On returnable basis) during transportation to measure the magnitude and duration of the impact in all three directions. The acceptance criteria and limits of impact in all three directions, which can be withstood by the equipment during transportation and handling, shall be submitted by the supplier during detailed engineering. The recording shall commence in the factory before dispatch and must continue till the unit is received/installed at destination sub-station. The data of electronic impact recorder(s) shall be downloaded at site and a soft copy of it shall be handed over to Engineer-in-charge. Further, within three weeks, the supplier shall communicate the interpretation of the data.

The equipment shall be suitable for vertical/horizontal transport as the case may be and suitable to withstand handling during transport and outdoor storage during transit. The supplier shall be responsible for any damage to the equipment during transit, due to improper and inadequate handling during transfer, loading and unloading. The easily damageable material shall be carefully packed and marked with the appropriate caution symbol. Whenever necessary, proper arrangement for lifting, such as lifting hooks etc. shall be provided. Any material found short inside the packing cases shall be supplied by supplier without any extra cost.

Each consignment shall be accompanied by a detailed packing list containing the following informations:-

- (a) Name of the consignee.
- (b) Details of consignment.
- (c) Destination.
- (d) Total weight of consignment.
- (e) Sign showing upper/lower side of the crate.
- (f) Handling and unpacking instructions.
- (g) Bill of materials indicating contents of each package.
- (h) Two sets of approved copies of drawings, instruction and commissioning manuals, approved test certificates and certificates of bought out items, approved copies of guarantee certificate.

The supplier shall ensure that the packing and bill of materials are approved by the owner before dispatching the materials.

13.0 SUPERVISION OF ERECTION, TESTING AND COMMISSIONING (ET&C):

The erection, testing and commissioning of the transformers shall be supervised by trained personnel (Engineer) of the supplier. The Engineer shall direct the sequence of ET& C. The Engineer shall correct in the field, any errors or omissions on the part of the supplier, in order to make the equipment and material properly perform in accordance with the intent of this specification. The Engineer shall also instruct the plant operators in the operation and maintenance of the commissioned equipment. The supplier shall be responsible for any damage to the equipment, on commissioning the same, if such damage results from faulty or improper ET&C procedure. Owner shall provide adequate

number of skilled/semi-skilled workers as well as all ordinary tools and equipment and cranes required for equipment erection, at his own expenses. Apart from the above, the owner shall not be responsible for any other expenses such as Engineer's salary, insurance against personal injuries to the Engineer etc. Special tools, if required for erection and commissioning, shall be arranged by the supplier at his cost and on commissioning, these shall be supplied to the owner, free of cost for future use.

14.0 QUANTITY AND DELIVERY REQUIREMENTS:

- (i) This is set out in Annexure-I of this Specification. The firm will submit a 'PERT CHART', indicating the manufacturing, inspection, testing and delivery schedule in details immediately after receipt of the purchase Order.
- (ii) The scope of supply shall also include supply of 2.5% extra quantity of bolts, nuts, washers, split pins, cotter pins and such other small loose items, free of cost in addition to the materials/equipment's as spelt out in this specification.

15.0 Values quoted in the G.T.P. and in details of loss calculations shall not differ. In case if it differs, then values quoted in the G.T.P. will be taken as final for all purposes.

ANNEXURE-I

SCHEDULE OF QUANTITY AND DELIVERY

Sl. No	Description of Materials	Quantity required
1.	20MVA, 220/33 KV Power Transformer.	01 No.

ANNEXURE-II

**MAXIMUM FLUX DENSITY, CORE WEIGHT & NO LOAD LOSS CALCULATION FOR
20MVA, 220/33 KV POWER TRANSFORMER**

[To be filled in by the Bidder]

Name of the bidder: -

Address:-

Type and Grade of Core material: -

Thickness [in mm]:-

Step No	Width of steps [mm]	Stack thickness [mm]	Gross Iron area [mm ²]
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
13.			
14.			

$$E = 4.44 \times f \times B \text{ max.} \times A_i \times N$$

Where E = L.V. winding rated voltage / phase = 33000 volts.

f = Rated frequency = 50 HZ. , B max. = Maximum flux density in Tesla.

1) Flux Density Calculation	
Gross iron area in sq.m =	
Stacking factor =	
A _i (Net iron area in sq.m) = Gross iron area in sq.m x stacking factor =	
N = Number of L.V. winding turns/phase=	
B max. (At rated voltage & frequency)= E/4.44 x f x A _i x N =	
B max [at Maximum System voltage (245 KV/36 KV) and minimum system frequency (48.5 HZ)]	

2) Core weight Calculation	
Core dia [in mm] =	
Window height [in mm] =	
Limb centre [in mm] =	
W=Weight of core = [3 x window height + 4 x limb centre + 2 x max. width] x Net iron area x Density of core =	

3) No load loss Calculation	
Core loss in watt/kg. from graph for grade/type of core material and selected Flux density=	
Building factor=	
Calculated No-load loss in watts =core weight x watts/kg. x Building factor=	
Guaranteed No-load loss in watts =	

NB: -

- 1) Specific loss vs. flux density graph for the type of core lamination to be used has to be furnished.
- 2) VA/Kg. Vs flux density graph for the core lamination to be used has to be furnished.
- 3) Any other factor assumed for above calculation to be explained with reasons.

ANNEXURE-III
DETAILS OF LOSS CALCULATIONS FOR 20 MVA, 220/33 KV POWER
TRANSFORMER
[To be filled in by the Bidder]

20MVA, 220/33KV

1)	Name of the Firm	
2)	Flux density as adopted for offered transformer design, at	
(i)	245/36 KV and 48.5 Hz [Tesla]	
(ii)	220/33 KV & 50.0Hz [Tesla]	
3)		
(i)	Core weight in Kg.	
(ii)	Gross core area [mm ²]	
(iii)	Stacking factor.	
(iv)	Net core iron area [mm ²] [ii x iii]	
(v)	No. of LV Turns/Phase	
(vi)	Building Factor	
4)		
(a)	Specific losses [W/Kg.]	
(i)	At designed flux density corresponding to 245/36KV and 48.5 Hz.	
(ii)	At designed flux density corresponding to 220/33KV and 50Hz.	
(b)	Volt ampere/Kg	
(i)	At designed flux density corresponding to 245/36 KV and 48.5 Hz.	
(ii)	At designed flux density corresponding to 220/33 KV and 50 Hz.	
5)	Calculated/guaranteed iron loss in KW at: -	
(i)	Rated voltage and rated frequency	
(ii)	Maximum system voltage and lowest system Frequency	
6)	Current density [A/Sq. mm] at normal tap for	
(i)	HV	
(ii)	Regulating	
(iii)	LV	
7)	Conductor size [in mm ²]	
(a)	HV	
(i)	Bare	
(ii)	Insulated	
(iii)	No of conductors in parallel	
(b)	Regulating winding	
(i)	Bare	
(ii)	Insulated	

(iii) No of conductors in parallel			
(c) L.V. winding			
(i) Bare			
(ii) Insulated.			
(iii) No. of conductors in parallel.			
8) Total Bare copper conductor area (A) (Sq.mm.)			
(i) HV			
(ii) LV			
(iii) Regulating			
9) No. of turns/phase(N) at	Highest tap	Lowest tap	Normal tap
(i) HV			
(ii) Regulating			
(iii) LV			
10) Internal Diameter (in mm.)			
(i) HV			
(ii) Regulating			
(iii) LV			
11) Outside Diameter (in mm.)			
(i) HV			
(ii) Regulating			
(iii) LV			
12) Mean Diameter (Dm) (in mm.)			
(i) HV			
(ii) Regulating			
(iii) LV			
13) Length of copper conductor(L)	Highest tap	Lowest tap	Normal tap
$\text{Pie} \times \text{Dm} \times \text{N}$			
(i) HV			
(ii) Regulating			
(iii) LV			
14) Per-phase resistance of winding	Highest tap	Lowest tap	Normal tap
(In ohms)			
At 75 deg. $C=0.0211 \times L/A$			
(i) HV			
(ii) Regulating			
(iii) LV			
15) $I^2 \cdot R$ loss for winding at 75 Deg C			
(i) At normal tap position (in KW)			
(ii) At maximum tap position (in KW)			
(iii) At minimum tap position (in KW)			
16) $I^2 \cdot R$ loss at 75 Deg C towards connecting leads for windings, bushings, OLTC etc.			

(i) At normal tap position (in KW)	
(ii) At maximum tap position (in KW)	
(iii) At minimum tap position (in KW)	
17) Eddy current losses in winding (in KW) at 75 Deg C	
(i) At normal tap position.	
(ii) At maximum tap position.	
(iii) At minimum. tap position.	
18) Stray losses in tank & other parts of transformer (in KW) at 75 Deg C	
(i) At normal tap position.	
(ii) At maximum tap position.	
(iii) At minimum tap position.	
19) Calculated guaranteed Load losses (in KW) at 75 Deg C [15 + 16 + 17 + 18]	
(i) At normal tap position.	
(ii) At maximum tap position.	
(iii) At minimum tap position.	
20) Guaranteed cooler loss [in KW]	
21) Computed/guaranteed total loss in KW at rated voltage and rated frequency	
[Copper loss + cooler loss + Iron loss]	
(i) At normal tap position	
(ii) At maximum tap position	
(iii) At minimum tap position	
22) Copper Weight (L X A X 8.89 X 10 ⁻³)	Bare
/ Insulated	
(i) HV	
(ii) Regulating	
(iii) LV	
(iv) For Tap connections, star connection and any other [please specify]	
(v) Total copper weight [i]+[ii]+[iii]+[iv]	

NB: -

Approximate value in weight and losses etc. are not allowed.

Tolerance of + 5% in weights may be quoted without any approximation

ANNEXURE-IV
GUARANTEED TECHNICAL PARTICULARS
[TO BE FILLED IN BY THE BIDDER, IN EXCEL FORMAT OF THE TECHNO
COMMERCIAL BID SHEET]

<u>Sl. No.</u>	<u>DESCRIPTION</u>	
1)	Name of the Manufacturer	
2)	Installation [indoor/outdoor]	
3)	Reference standards	
4)	Continuous Ratings	
	(a) Type of cooling	
	(b) Rating [MVA]	
	(i) With ONAN cooling	
	(ii) With ONAF cooling	
	(c) Rated voltage	
	(i) HV [KV-rms.]	
	(ii) LV [KV-rms.]	
	(d) Highest system voltage	
	(i) HV [KV-rms.]	
	(ii) LV [KV-rms.]	
	(e) Rated frequency with $\pm\%$ variation	
	(f) Number of phases	
	(g) Current at rated full load and on Principal tap	
	(i) HV [Amps]	
	(ii) LV [Amps]	
5)	Connections	
	HV	
	LV	
6)	Connection symbol and vector group	
7)	Temperature rise	
	(a) Temperature rise of oil above Ambient temperature [by Thermometer]	
	(i) At full ONAN rating [$^{\circ}\text{C}$]	
	(ii) At full ONAF rating [$^{\circ}\text{C}$]	
	(b) Temperature rise of windings above Ambient temperature [By resistance method]	
	(i) At full ONAN rating [$^{\circ}\text{C}$]	
	(ii) At full ONAF rating [$^{\circ}\text{C}$]	
	(c) Temperature gradients between windings & oil.	
	(d) Limit of Hot spot temperature for which the Transformer is designed [$^{\circ}\text{C}$]	
	(e) Period of operation of transformer at full load without calculated winding hot spot temperature exceeding 140°C and with	

	(i) 50% Coolers		
	(ii) 100% Coolers		
8)	Type of ON load tap changing switch		
9)	Tapping on windings for		
	(i) Constant flux/variable flux/combined Regulation		
	(ii) Tapping provided at		
	(iii) Number of steps		
	(iv) Range of tapping for variation [+ Percent to-Percent]		
10)	(i) No load loss at rated voltage and frequency At Principal tap [KW]		
	(ii) No load loss at the voltage corresponding to Highest tap [KW]		
11)	Load loss at rated output, rated frequency, Corrected for 75 °C winding temperature at: -	ONAN	ONAF
	(i) Principal tap [In KW]		
	(ii) Highest tap [In KW]		
	(iii) Lowest tap [In KW]		
12)	Auxiliary losses at rated output, normal ratio, Rated voltage, rated frequency and ambient Temperature [KW]		
13)	Total losses at normal ratio inclusive of Auxiliary equipment losses [KW]		
14)	Positive sequence impedance on rated MVA Base at rated current and frequency at 75°C Winding temperature at		
	(i) Principal tap [%]		
	(ii) Highest tap [%]		
	(iii) Lowest tap [%]		
15)	Zero sequence impedance at reference Temperature of 75°C at principal tap [%]		
16)	% Reactance at rated MVA based at rated Current and rated frequency at		
	(i) Principal tap [%]		
	(ii) Highest tap [%]		
	(iii) Lowest tap [%]		
17)	% resistance at rated MVA base at rated Current and rated frequency at		
	(i) Principal tap [%]		
	(ii) Highest tap [%]		
	(iii) Lowest tap [%]		
18)	% Impedance at rated MVA base at rated Current and rated frequency at		
	(i) Principal tap [%]		
	(ii) Highest tap [%]		

	(iii) Lowest tap [%]		
19)	(a) Polarisation index i.e. ratio of Megger values At 600secs to 60secs, (H.V. to E, L.V. to E, H.V to L.V).		
	(b) Regulation at full load and 75°C winding Temperature expressed as a percentage of Normal voltage		
	(i) At unity power factor [%]		
	(ii) At 0.8 power factor [lagging][%]		
20)	Efficiency at 75 Deg C Winding Temperature as derived from guaranteed Loss figures and at	Unity PF	0.8 PF
	(a) At full load [%]		
	(b) At $\frac{3}{4}$ load [%]		
	(c) At $\frac{1}{2}$ load [%]		
21)	(i) Maximum efficiency [%]		
	(ii) Load at which maximum efficiency occurs [% of full load]		
22)	Time in minutes for which the transformer can Be run at full load without exceeding the Maximum permissible temperature at Reference ambient temperature when supply to: -		
	(i) Fans are cut off		
23)	Short time thermal rating of		
	(i) HV winding in KA and duration in seconds		
	(ii) LV winding in KA and duration in seconds		
24)	Permissible over loading: -		
	(a) HV winding		
	(b) LV winding		
25)	Terminal arrangement		
	(a) High voltage [HV]		
	(b) Low voltage (LV)		
	(c) Neutral		
26)	Insulating and cooling medium		
27)	(a) Test voltage		
	(i) Lightning impulse withstand test voltage [KVP]		
	(ii) Power frequency withstand test voltage [dry And wet] [for 1 minute] [KV-rms.]		
	(iii) Separate source withstand voltage (KV- rms)		
28)	Partial discharge level as per relevant up-to-date IEC		
29)	Noise level when energized at normal voltage, Frequency without load and with all cooling Fans in running condition		

30)	External short circuit withstand		
31)	Over-fluxing withstand capability of the transformer.		
32)	DETAILS OF CORE		
	(a) Type of core construction		
	(b) Type of corner joints of the core		
	(c) Flux density as adopted for offered transformer design at		
	(i) Rated voltage [220/33 KV] & rated Frequency 50 Hz [in Tesla]		
	(ii) Highest system voltage [245/36 KV] and Lowest system frequency [48.5Hz] [In Tesla]		
	(d) No load current, no load loss and no load power Factor at normal ratio and frequency [Amp/KW/PF] [With reference to 33KV side]		
	(i) 10 percent of rated voltage		
	(ii) 25percent of rated voltage		
	(iii) 50 percent of rated voltage		
	(iv) 85 percent of rated voltage		
	(v) 100 percent of rated voltage		
	(vi) 105percent of rated voltage		
	(vii) 110 percent of rated voltage		
	(viii) 112.5 percent of rated voltage		
	(ix) 115 percent of rated voltage		
	(x) 120 percent of rated voltage		
	(xi) 121 percent of rated voltage		
	(xii) 125 percent of rated voltage		
	(e) Core laminations:-		
	(i) Make & type[HIB/Laser grade] of core Material		
	(ii) BIS Grade of core laminations		
	(iii) Thickness of core lamination [mm]		
	(iv) Specific loss [watt/Kg.] at Design Flux Density at rated voltage & rated frequency		
	(v) Specific loss [watt/Kg.] at Design Flux Density at highest system voltage & lowest system frequency		
	(vi) Whether specific core loss graph [Flux density vs. watt/Kg.] Submitted		
	(vii) VA/Kg at Design Flux Density at Rated voltage & rated frequency		
	(viii) VA/Kg at Design Flux Density at 110% of Rated voltage & rated frequency		
	(ix) VA/Kg at Design Flux Density at 121% of Rated voltage & rated frequency		
	(x) VA/Kg. at Design Flux Density and at Highest system voltage & lowest system frequency		

	(xi) Whether VA/Kg. Vs. flux density graph submitted.		
	(xii) Insulation of core laminations		
	(f) CORE ASSEMBLY:-		
	(i) Core diameter [mm]		
	(ii) Core window height [mm]		
	(iii) Core leg centre [mm]		
	(iv) Gross core cross-sectional area [m ²]		
	(v) Whether details of core widths, stacks and Calculation furnished as per enclosed annexure		
	(vi) Distance between centres [mm]		
	(vii) Total height of core [mm]		
	(viii) core belting		
	1) Details of core belting.		
	2) Material, grade & type.		
	3) Width.		
	4) Thickness.		
	5) Fixing method.		
	(ix) Details of top end frame.		
	(x) Details of Bottom end frame.		
	(xi) Details of clamp plate [Material, thickness, Insulation]		
	(xii) Core stacking factor		
	(xiii) Net core area Sq. m.		
	(xiv) Total core weight [kg]		
	(xv) Building Factor		
	(xvi) Core loss basing on core loss graph at operating Flux density [rated voltage and rated Frequency] [KW]		
	(xvii) Margin towards corner joints, cross fluxing etc [KW]		
	(xviii) Total core loss at rated voltage and rated Frequency [xiv+xvii] [KW]		
	(xix) Dielectric loss at rated voltage and rated Frequency [KW]		
	(xx) No load loss at rated voltage and rated Frequency [xviii+xix] [KW]		
	(g) Describe location/method of core grounding		
	(h) Details of oil ducts in core		
	(i) Peak value of magnetising Inrush current (% of HV rated current).		
33)	DETAILS OF WINDINGS:	HV	LV

	(a) Type of winding		
	(b) Material of the winding conductor		
	(c) Maximum current density of windings [At rated current] [Normal Tap] and Conductor area	Conductor/ Current area [cm ²] density [A/cm ²]	
	(i) HV		
	(ii) Regulating		
	(iii) LV		
	(d) Whether HV windings are interleaved		
	(e) Whether windings are pre-shrunk?		
	(f) Whether adjustable coil clamps are provided for H.V. and L.V windings?		
	(g) Whether steel rings are used for the windings? If so, whether these are split?		
	(h) Whether electrostatic shields are provided to Obtain uniform voltage distribution in the windings?		
	(i) Winding Insulation	Type & class. Graded or Ungraded	
	(i) HV		
	(ii) Regulating		
	(iii) LV		
	(j) Insulating material used for		
	(i) H.V. & Regulating winding.		
	(ii) L.V Winding		
	(iii) For core bolts washers and end plates.		
	(iv) Tapping connection.		
	(k) Insulating material used between		
	(i) H.V. and L.V. winding		
	(ii) H.V. and Regulating winding.		
	(iii) Core and L.V winding.		
	(iv) H.V. to H.V. winding [between phases]		
	(l) Type of axial coil supports		
	(i) H.V. winding		
	(ii) LV winding		
	(iii) Regulating winding		
	(m) Type of radial coil supports		
	(i) HV winding		
	(ii) Regulating winding		
	(iii) LV winding		
	(n) Maximum allowable torque on coil	HV	LV
	Clamping bolts		
	(o) Bare conductor size (mm).		
	(p) Insulated conductor size (mm)		
	(q) No. of conductors in parallel (Nos.)		

	(r) No. of turns/phase		
	(s) No. of discs/phase		
	(t) No. of turns/disc		
	(u) Gap between discs (mm)		
	(v) Inside diameter (mm).		
	(w) Outside diameter (mm).		
	(x) Axial height after shrinkage (mm)		
	(y) D.C.RESISTANCE		
	(i) L.V winding at 75 ° C (Ohms).		
	(ii) HV winding and Regulating winding at normal Tap at 75° C (Ohms)		
	(iii) HV winding and Regulating winding at highest Tap at 75° C (Ohms)		
	(iv) HV winding and regulating winding at lowest Tap at 75° C (Ohms)		
	(z) $I^2 \cdot R$ loss for winding at 75° C		
	(i) At normal tap position (in KW)		
	(ii) At maximum tap position (in KW)		
	(iii) At minimum tap position (in KW)		
	(aa) $I^2 \cdot R$ loss at 75° C towards connecting leads for windings, bushings, OLTC etc.,		
	(i) At normal tap position (in KW)		
	(ii) At maximum tap position (in KW)		
	(iii) At minimum tap position (in KW)		
	(bb) Eddy current losses in winding (in KW) at 75° C		
	(i) At normal tap position.		
	(ii) At maximum tap position.		
	(iii) At minimum. tap position.		
	(cc) Stray losses in tank & other parts of transformer (in KW) at 75° C		
	(i) At normal tap position.		
	(ii) At maximum tap position.		
	(iii) At minimum tap position.		
	(dd) Any special measures taken to reduce eddy Current losses and stray losses, mention in details.		
	(ee) Load losses at 75°C [I^2R + stray].		
	(i) Normal tap position [KW].		
	(ii) Highest tap position [KW].		
	(iii) Lowest tap position [KW].		
	(ff) Details of special arrangement provided to Improve surge voltage distribution in the Windings		
	(gg) Tan delta (Power factor) of winding (Max.) At measured temperature		
34)	BUSHINGS		
	(a) Make and type		
	(i) Rated voltage class [KV-rms.]		

	(ii) Rated current [Amps.]		
	(b) Lightning Impulse withstand test voltage [1.2/50 microsecond][KVP]		
	(c) Switching surge withstand test voltage [KVP]		
	(d) Power frequency withstand test voltage		
	(i) Wet for 1 minute [KV-rms]		
	(ii) Dry for 1 minute [KV-rms]		
	(e) Power frequency visible corona discharge Voltage [KV-rms]		
	(f) Partial discharge level [PC]		
	(g) Minimum creepage distance in mm		
	(h) Minimum creepage distance in mm [protected]		
	(i) Whether test-tap is provided?		
	(j) Quantity and grade of oil in bushing and Specification of oil used [Kg.]		
	(k) Weight of assembled bushing [Kg.]		
	(l) Minimum clearance height for removal of Bushing [mm]		
	(m) Under oil flashover or puncture impulse voltage [KVP]		
	(n) Under oil flashover or puncture power frequency Voltage (KV-rms)		
	(o) Phase to earth clearance in air of live parts at The top of bushings		
	(p) Maximum tan delta value at measured temperature		
35)	Minimum clearance [mm]	Between Windings	Phase to Ground
	(a) Out of Oil		
	HV		
	LV		
	(b) In Oil		
	(i) LV to Core		
	(ii) LV to top yoke		
	(iii) LV to bottom yoke		
	(iv) LV to HV (radially)		
	(v) HV to Regulating (radially)		
	(vi) HV to top yoke		
	(vii) HV to bottom yoke		
	(viii) Regulating to top yoke		
	(ix) Regulating to bottom yoke		
	(x) Reg. winding to Reg. winding		
	(xi) Regulating winding to tank		
	(a) Length wise		
	(b) Breadth wise		
	(c) Width wise		

	N.B: Winding Arrangement-CORE-LV-HV-REGULATING		
36)	Weight [Tolerance + 5%]		
	[Approximate value is not allowed]		
	(a) Core [Kg.]		
	(b) Core with clamping [Kg.]		
	(c) H.V. winding insulated conductor [Kg.]		
	(d) L.V. winding insulated Conductor [Kg.]		
	(e) Regulating winding insulated Conductor [Kg]		
	(f) Coils with insulation [Kg.]		
	(g) Core and winding [Kg]		
	(h) Oil required for first filling [Litre/Kg.]		
	(i) Tank and fittings with accessories [Kg.]		
	(j) Untanking weight [Kg.]		
	(k) Total weight with oil and fittings Along with accessories [Kg]		
37)	DETAILS OF TANK		
	(a) Material for Transformer tank		
	(b) Type of tank		
	(c) Thickness of sheet [No approximate value to be mentioned]		
	(i) Sides [mm]		
	(ii) Bottom [mm]		
	(iii) Cover [mm]		
	(iv) Radiators [mm]		
	(d) Inside dimensions of main tank [No approximation in dimensions to be used]		
	(i) Length [mm]		
	(ii) Breadth [mm]		
	(iii) Height [mm]		
	(e) Outside dimensions of main tank [No approximation in dimensions to be used]		
	(i) Length [mm]		
	(ii) Breadth [mm]		
	(iii) Height [mm]		
	(f) Thickness of spray galvanisation of tank Bottom		
	(g) Vacuum recommended for hot oil Circulation [torr]		
	(h) Vacuum to be maintained during oil filling in Transformer tank [torr]		
	(i) Vacuum to which the tank can be subjected Without distortion [torr]		
	(j) No. of bi-directional wheels provided		
	(k) Track gauge required for the wheels		
	(i) Transverse axis		
	(ii) Longitudinal axis		

	(l) Type and make of pressure relief device and Minimum pressure at which it operates [Kpa]		
38)	CONSERVATOR		
	(a) Total volume [Litres]		
	(b) Volume between the highest and lowest visible Oil levels [Litres]		
	(c) Power required by heaters [If provided][KW]		
	(d) Conservator sheet thickness (mm.)		
39)	OIL QUALITY		
	(a) Governing standard		
	(b) Density in gms/cu-cm		
	(c) Kinematics viscosity in CST		
	(d) Inter facial tension at 27°C in N/m		
	(e) Flash point in °C		
	(f) Pour point in °C		
	(g) Acidity [neutralization value] in mg of KOH/gm		
	(h) Corrosive sulphur in %		
	(i) Electric strength [Breakdown voltage]		
	(i) As received [KV-rms]		
	(ii) After treatment [KV-rms]		
	(j) Dielectric dissipation factor [Tan-delta] at 90°C		
	(k) Saponification value in mg of KOH/gm		
	(l) Water content in PPM.		
	(m) Specific resistance		
	(i) At 90°C [ohm-cm]		
	(ii) At 27 °C [ohm-cm]		
	(n) N- dm analysis		
	CA%		
	CM%		
	CP%		
	(o) Oxidation stability		
	(i) Neutralization value after oxidation		
	(ii) Total sludge after oxidation		
	(p) Characteristic of oil after ageing test as per ASTM-D-1934		
	(i) Specific resistance at		
	27°C [ohm-cms]		
	90°C [ohm-cms]		
	(ii) Tan delta		
	(iii) Sludge content Neutralization		
	(iv) Number Percentage of Naphthenic		
	(v) Content Percentage of paraffinic		
	(vi) Content		

	(vii) Details of oil preserving equipment offered		
40)	RADIATORS		
	(a) Overall dimensions l*b*h [mm]		
	(b) Total weight with oil [Kg.]		
	(c) Total weight without oil [Kg.]		
	(d) Thickness of radiator tube [mm]		
	(e) Types of mounting		
	(f) Vacuum withstand capability		
	(g) Total radiating surface in sq.m		
	(h) Type and make of material used for the Radiators		
	(i) Total number of radiators/Banks for Transformer and dimensions of tubes		
	(j) Thickness of hot dip galvanization of radiators.		
41)	COOLING EQUIPMENT	Fan Motor	
	(a) Make and Type		
	(b) No. of connected units		
	(c) No. of stand-by units		
	(d) Rated power input		
	(e) Capacity [cu-m/min. or] [litres/min]		
	(f) Rated voltage [volts]		
	(g) Locked rotor current [Amps.]		
	(h) Efficiency of motor at full load [%]		
	(i) Temperature rise of motor at full load [°C]		
	(j) BHP of driven equipment		
	(k) Temperature range over which control is adjustable [°C]		
	(l) Whether the fans are suitable for Continuous operation at 85 % of Their rated Voltage		
	(m) Estimated time constant in hours for		
	(i) Natural cooling		
41)	(ii) Forced air cooling		
42)	GAS AND OIL OPERATED RELAY		
	(a) Make		
	(b) Type		
	(c) Size		
	(d) Whether supervisory alarm and trip contacts Provided and their sizes and Nos.		
43)	TEMPERATURE INDICATORS	Oil Temp. Indicator	Winding Temp Indicator
	(a) Make and type		
	(b) Permissible setting ranges for alarm and trip		
	(c) Number of contacts		
	(d) Current rating of each contact		
	(e) Whether supervisory alarm contacts provided?		

	(f) Size [l*b*d]		
	(g) Nos.		
	(h) Ratio and type of CT used for winding Temperature indicators		
44)	APPROXIMATE OVERALL DIMENSIONS OF TRANSFORMER INCLUDING COOLING SYSTEM, TAP CHANGING GEAR ETC		
	(a) Length [mm]		
	(b) Breadth [mm]		
	(c) Height [mm]		
45)			
	(a) Minimum clearance height for lifting core and Winding from tank [mm]		
	(b) Minimum clearance height for lifting tank cover [mm]		
46)	SHIPPING DETAILS		
	(a) Approximate weight of heaviest package [Kg.]		
	(b) Approximate dimensions of largest Package [Kg.]		
47)	Transformers will be transported with oil/gas.		
48)	Size of rail recommended for the track.		
49)	Details of Neutral Current Transformers		
	(a) Quantity		
	(b) Type and voltage class		
	(c) No. of cores		
	(d) Ratio		
	(e) VA burden		
	(f) Accuracy class		
	(g) Minimum knee point voltage [volts]		
	(h) Maximum magnetization current at minimum Knee point voltage [mA]		
	(i) Maximum secondary winding resistance at 75°C [ohms]		
50)	MARSHALLING KIOSK		
	(a) Make and type		
	(b) Details of apparatus proposed to be housed in the Kiosk		
51)	Details of anti-earthquake device provided, if any		
52)	Separate conservator and Buchholz relay provided		
53)	TAP CHANGING EQUIPMENT		
	[These details refer to the basic rating of O.L.T.C. as guaranteed by OLTC manufacturers]		
	(a) Make		
	(b) Type		
	(c) Power flow [Uni.-directional/bi - directional/ Restricted bi-directional]		

	(d) Rated voltage to earth [KV]		
	(e) Rated current [Amps.]		
	(f) Step voltage [volts]		
	(g) Number of steps		
	(h) Control - manual/local-electrical/remote-Electrical		
	(i) Voltage control [Automatic/Non -automatic]		
	(j) Line drop compensation provided/not provided		
	(k) Parallel operation		
	(l) Protective devices		
	(m) Auxiliary supply details		
	(n) Time for complete tap change [one step][Sec.]		
	(o) Diverter selector switch transient time [cycles] Value of short circuit current [Amps] [minimum] Along with duration		
	(p) Maximum impulse withstand test voltage with 1.2/50 microseconds full wave between switch Assembly and ground [KVP]		
	(q) Maximum power frequency test voltage between Switch assembly and earth [KV-rms]		
	(r) Maximum impulse withstand test voltage with 1.2/50 microseconds across the tapping range [KVP]		
	(s) Approximate overall dimensions of tap changer [W*B*D] in mm		
	(t) Approximate overall weight [Kg.]		
	(u) Approximate mass of oil [Kg.]		
	(v) Particulars of the OLTC control panel For installation in control room		
54)	DRIVING MECHANISM BOX		
	(a) Make and type		
	(b) Details of apparatus proposed to be housed In the box		
55)	Types of terminal connectors and drawing No		
	(a) HV		
	(b) LV		
56)	Details of painting, galvanization conforms to this Specification [Yes/No]		
57)	Type of oil level indicator and whether Supervisory alarm contact for low oil level provided [Yes/No]		
58)	Type and size of thermostat to be used		
59)	No. of breathers provided [Nos.]		
60)	Type of dehydrating agent used for breathers		
61)	Valve sizes and numbers		
	(a) Drain valves- mm-Nos.		
	(b) Filter valves- mm-Nos.		
	(c) Sampling valves-mm-Nos.		

	(d) Radiator valves-mm-Nos.		
	(e) Other valves-mm-Nos.		
62)	(a) Type and make of PRV.		
	(b) No. of each type of devices per transformer		
	(c) Min. pressure at which device operates.		
63)	Please enclose the list of accessories and fittings, being provided on Transformer, Please confirm, These are as stipulated in the tender.		
64)	Whether the transformer, covered is fully type tested And if so, whether copies of type test certificates, enclosed with the tender		
65)	Whether Bidder/ Transformer Manufacturer can supply transformer, wound on vertical coil winding machine. Preference shall Be given to the Bidder/ Transformer Manufacturer who will ensure supply of transformer wound on vertical winding machines.		
66)	In case Sl.No.65 is not confirmed, what are the additional pre-cautions, which shall be taken by the tenderer to justify that the coil, wound on horizontal machine shall be equivalent in all respects to that which are wound on vertical winding machine.		
67)	What are the arrangements, available for jointing the Winding. Preference shall be given to the tenderer using high-frequency brazing machines. In case other jointing techniques are used; adequacy of the same is to be recorded. Please note that bolted joints in the winding are not acceptable. This should be confirmed here.		
68)	Please confirm that you will guarantee maximum Impedance variation between phases within the Limit of 2% only		
69)	(a) Please confirm that the transformer shall be dried by vapour-phase drying method. Please Specify level of dryness		
	(b) In case, other methods of drying are used, The level of dryness, so achieved should be Identical to that by VPD, Adequacy of such System should be justified.		
70)	Please confirm whether the In-House facilities for all Routine tests as per this Tender Specification are available With the Bidder/ Transformer Manufacturer and the Bidder shall agree to conduct These tests on the transformer in the event of order		
71)	Whether the Bidder/ Transformer Manufacturer has got In-House core-cutting Facility for cutting core materials for the transformer Ratings as offered. (YES/NO)		

72)	If ‘Yes’, following information’s/confirmations required:			
	(a) Name of the manufacturer of HIB Grade core material from whom core materials will be directly imported or through their accredited marketing organization of repute. If to be imported through the accredited Marketing Organisation, Please state the name of such Marketing Organisation and please enclose the relevant documents with the Tender Offer regarding accreditation of the said Marketing Organisation by the manufacturer of the HIB core material.			
	(b) Grade, Trade Name and Thickness of the Core material, to be imported			
	(c) Whether agreed for witnessing of core materials By OPTCL representative(s)			
	(d) Whether, the Bidder has past experience towards direct import of core materials. If ‘YES’, the copies of recent past Import documents to be furnished with the Tender Offer (Please state, whether the said import documents are enclosed with the Tender Offer)			
	(e) Whether, the Bidder/ Transformer Manufacturer has got In-House CNC Machine Facility for cutting of core materials			
	(f) Whether the Bidder/ Transformer Manufacturer is agreed to follow the procedures, As stipulated at Cl.No.5.4.8 (o), (p) & (q) of this Technical Specification, as applicable for those, who have got In-House core-cutting facility			
73)	If the Bidder/ Transformer Manufacturer has no In-House core-cutting Facility, the following information’s/confirmations Are required: -			
	(a) Name of the core manufacturer of core materials from whom core materials will be directly imported or through their accredited marketing organization of repute. If to be imported through the accredited Marketing Organisation, Please state the name of such Marketing Organisation and please enclose the relevant documents with the Tender Offer regarding accreditation of the said Marketing Organisation by the manufacturer of the HIB core material.			
	(b) Grade, Trade Name and Thickness of the Core material, to be imported			
	(c) Name of the core-cutting vendor and whether the said vendor has got In-House CNC Machine facility for cutting of core materials and whether the said vendor has been accredited by ISO			

	(d) Whether, the Bidder has past experience towards direct import of core materials. If 'YES', the copies of recent past Import documents to be furnished with the Tender Offer (Please state, whether the said import documents are enclosed with the Tender Offer)		
	(e) Whether the Bidder is agreed to follow the procedures, as stipulated at Cl.No.5.4.8 (o), (p) &(q)(1), (2), (3), (4), (5),(6) & (7) of this Technical Specification, as applicable for those, who have got no In-House core-cutting facility.		
74)	Please confirm that the facility for partial discharge test Is available with the tenderer and the tenderer shall agree to conduct This test on transformer in the event of order.		

ANNEXURE – V

ADDITIONAL SCHEDULE OF INFORMATIONS

(To be furnished by the bidder along with the Tender Offer)

<u>Sl. No</u>	<u>Item</u>	<u>Remarks</u>
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ANNEXURE - VI.

CHECK-LIST TOWARDS TYPE TEST REPORTS

[To be filled in by the Bidder]

Name of the type test	Date of test	Name of the Laboratory where the test has been conducted	Whether Laboratory is Govt. Approved.	Name of the Govt. Organisation Which has witnessed the type Test.	Whether the test report is valid as per Clause No.6.4.1 of TS	Whether the copy of test report in complete shape along with the drawings etc. furnished Or not?	Whether the type tested 20MVA, 220/33 KV transformer or higher capacity(Both MVA & Voltage rating) fulfil the technical requirements as per TS	Remarks

ANNEXURE – VII

CALIBRATION STATUS OF TESTING EQUIPMENTS AND INSTRUMENTS / METERS

[To be filled in by the Bidder]

Name of the Test.	Meters & Equipment required for the corresponding test with range accuracy, Make and Sl.No.	Date of calibration	Due date of calibration	Name of the Calibrating Agency.	Whether calibrating agency is Govt. Approved.	Whether documents related to Govt. approval of the Calibrating Agency furnished.	Whether the meters/equipments fulfil the accuracy class as per calibration report.	Whether calibrating Agency has put any limitation towards the use of the particular meters/equipments. If Yes, state the limitations.	In spite of imposed limitations, whether the particular meter/equipments can still be used. Justify its use for corresponding test(s)	Remarks.

ANNEXURE - VIII.
CHECK - LIST FOR DELIVERY SCHEDULE
[To be filled in by the Bidder]

<u>Sl. No.</u>	<u>Description of the equipment</u>	<u>Quantity</u>	<u>Delivery Schedule</u>
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PART-4
220kV & 33kV CONTROL AND RELAY PANEL

TECHNICAL SPECIFICATION FOR CONTROL & RELAY PANEL

1.0 SCOPE OF SUPPLY:

This specification covers design, engineering, manufacture, assembly stage testing, and inspection and testing before supply, packing, forwarding and delivery of Protection & relay panels for **220/33kV TFL Substation at Talcher, Odisha.**

The panels shall normally be simplex type board and in some special case duplex type board. The Simplex panel shall consist of a vertical front panel with equipment mounted thereon and having wiring access from either front or rear for relay panels. In case of panel having width more than 800mm, double leaf-doors shall be provided. Doors shall have handles with either built-in locking facility or will be provided with pad-lock.

2.0 CONSTRUCTIONAL FEATURES:

Protection and Relay Board shall be of panels of simplex type design. It is the responsibility of the Supplier to ensure that the equipment specified and such unspecified complementary equipment required for completeness of the protective/control schemes is properly accommodated in the panels without congestion and if necessary, provide panels with larger dimensions. No price increase at a later date on this account shall be allowed.

Panels shall be completely metal enclosed and shall be dust, moisture and vermin proof. The enclosure shall provide a degree of protection of at least IP-41 as per IEC 60529 or equivalent. Relay casings shall have a degree of protection of IP-50 as per IEC 60529 or equivalent.

Panels shall be free standing, floor mounting type and shall comprise structural frames completely enclosed with specially selected smooth finished, cold rolled sheet steel of thickness not less than 3 mm for weight bearing members of the panels such as base frame, front sheet and door frames, and 2.0mm for sides, door, top and bottom portions. There shall be sufficient reinforcement to provide level transportation and installation.

All doors shall be transparent removable covers and panels shall have neoprene gaskets all around conforming to the provision of IS 11149. However, XLPE gaskets can also be used for fixing protective glass doors. Ventilating louvers, if provided shall have screens and filters. The screens shall be made of either brass or GI wire mesh. The ventilating louvers shall be so designed that the dust shall not enter inside the panel.

Design, materials selection and workmanship shall be such as to result in neat appearance, inside and outside with no welds, rivets or bolt head apparent from outside, with all exterior surfaces true and smooth.

Panels shall have base frame with smooth bearing surface, which shall be fixed on the embedded foundation channels/insert plates. Anti-vibration strips made of shock absorbing materials that shall be supplied by the supplier, shall be placed between panel & base frame.

Cable entries to the panels shall be from the bottom. Cable gland plate fitted on the bottom of the panel shall be connected to earthing of the panel/station through a flexible braided copper conductor rigidly.

Panels of modern modular construction would also be acceptable.

Bay wise Bay Control Unit i.e. BCU, Breaker control switch, Energy meter, Numerical protective relays along with required Auxiliary / Multiplication / Tripping / Supervision Relays & Push Buttons shall be accommodated in Protection & Relay Panels for 220 & 33KV Bays as per the Protection Single Line Diagram.

3.0 MOUNTING:

All equipment on and in panels shall be mounted and completely wired to the terminal blocks ready for external connections. The equipment on front of panel shall be mounted flush.

No equipment shall be mounted on the doors.

Equipment shall be mounted such that removal and replacement can be accomplished individually without

interruption of service to adjacent devices and are readily accessible without use of special tools. Terminal marking on the equipment shall be clearly visible.

The Supplier shall carry out cut out, mounting and wiring of the free issue items supplied by others which are to be mounted in his panel in accordance with the corresponding equipment manufacturer's drawings. Cut outs if any, provided for future mounting of equipment shall be properly blanked off with blanking plate.

The centre lines of switches, push buttons and indicating lamps shall be not less than 750mm from the bottom of the panel. The centre lines of relays, meters and recorders shall be not less than 450mm from the bottom of the panel.

The centre lines of switches, push buttons and indicating lamps shall be matched to give a neat and uniform appearance. Like-wise the top lines of all meters, relays and recorders etc. shall be matched.

4.0 PANEL INTERNAL WIRING:

Panels shall be supplied complete with interconnecting wiring provided between all electrical devices mounted and wired in the panels and between the devices and terminal blocks for the devices to be connected to equipment outside the panels. When panels are arranged to be located adjacent to each other all inter panel wiring and connections between the panels shall be furnished and the wiring shall be carried out internally.

All wiring shall be carried out with 650V grade, single core, stranded copper conductor wires with PVC insulation shall be FRLS & C1 type, vermin and rodent proof. The minimum size of the multi-stranded copper conductor used for internal wiring shall be as follows:

- All circuits except current transformer circuits and voltage transfer circuits meant for energy metering - one 1.5mm sq. per lead.
- All current transformer circuits one 2.5 sq.mm lead.
- Voltage transformer circuit for energy meters: Two 2.5 mm sq. per lead.

All internal wiring shall be securely supported, neatly arranged, readily accessible and connected to equipment terminals and terminal blocks. Wiring gutters & troughs shall be used for this purpose.

Auxiliary bus wiring for AC and DC supplies, voltage transformer circuits, annunciation circuits and other common services shall be provided near the top of the panels running throughout the entire length of the panels.

Wire termination shall be made with solder-less crimping type and tinned copper lugs, which firmly grip the conductor. Insulated sleeves shall be provided at all the wire terminations. Engraved core identification plastic ferrules marked to correspond with panel wiring diagram shall be fitted at both ends of each wire. Ferrules shall fit tightly on the wire and shall not fall off when the wire is disconnected from terminal blocks. All wires directly connected to trip circuit breaker or device shall be distinguished by the addition of red coloured unlettered ferrule.

The wire numbers shown in the wiring diagram shall be in accordance with IS375/BS152/BS156. All wires directly connected to trip circuit breaker or devices shall be distinguished by addition of a red coloured or lettered ferrule. Number 6 and 9 shall not be used.

Longitudinal troughs extending throughout the full length of the panel shall be preferred for inter panel wiring. Inter-connections to adjacent panel shall be brought out to a separate set of terminal blocks located near the slots of holes meant for taking the inter-connecting wires.

Accidental short circuiting of certain wires is likely to result in malfunction of equipment, such as closing or tripping of a breaker or positive and negative wires, these wires shall not be terminated on adjacent terminal blocks.

The unused space on the front or rear of the panels shall be kept clear of wiring to facilitate addition of devices

without rewiring associated portion of the panels.

Terminations on T.B. shall be grouped function wise on one region of T.B. (may not be full T.B) to take outlet connections in one cable for the function.

Supplier shall be solely responsible for the completeness and correctness of the internal wiring and for the proper functioning of the connected equipment.

5.0 TERMINAL BLOCKS:

All internal wiring to be connected to external equipment shall terminate on terminal blocks. Terminal blocks shall be 650 V grade and have 10 A continuous rating, moulded piece, complete with insulated barriers, stud type terminals, washers, nuts and lock nuts. Markings on the terminal blocks shall correspond to wire number and terminal numbers on the wiring diagrams. All terminal blocks shall have shrouding with transparent unbreakable material.

Moulding materials shall be self-extinguishing or resistant to flame propagation, substantially non hydroscopic and shall not carbonized when tested for tracking. The insulation between any terminal and frame work between adjacent terminals shall with stand test of 2kV rms. For one minute. The moulding shall be mechanically robust to withstand handling while making terminations.

Disconnecting type terminal blocks for current transformer and voltage transformer secondary leads shall be provided. Also current transformer secondary leads shall be provided with short circuiting and earthing facilities.

At least 20% spare terminals shall be provided on each panel and these spare terminals shall be uniformly distributed on all terminal blocks.

Unless otherwise specified, terminal blocks shall be suitable for connecting the following conductors of external cable on each side

- All CT & PT circuits: minimum of two of 2.5mm Sq. copper.
- AC/DC Power Supply Circuits: One of 6mm Sq. Aluminium.
- All other circuits: minimum of one of 2.5mm Sq. Copper.

There shall be a minimum clearance of 250mm between the first row of terminal blocks and the associated cable gland plate or panel side wall. Also the clearance between two rows of terminal blocks edges shall be minimum of 150mm.

Arrangement of the terminal block assemblies and the wiring channel within the enclosure shall be such that a row of terminal blocks run in parallel and close proximity along each side of the wiring-duct to provide for convenient attachment of internal panel wiring. The side of the terminal block opposite the wiring duct shall be reserved for the Owner's external cable connections. All adjacent terminal blocks shall also share this field wiring corridor. All wiring shall be provided with adequate support inside the panels to hold them firmly and to enable free and flexible termination without causing strain on terminals.

The number and sizes of the Owner's multi core incoming external cables will be furnished to the Supplier after placement of the order. All necessary cable terminating accessories such as gland plates, supporting clamps & brackets, wiring troughs and gutters etc. (except glands & lugs) for external cables shall be included the scope of supply.

6.0 PAINTING:

All sheet steel work shall be phosphated in accordance with the IS: 6005 "Code of practice for phosphating iron and steel". Panels to be pre-treated as per IS 6005, Phosphating shall be class C as per IS 6005. Phosphating surface shall be rinsed and passivated before application of stoved lead oxide primer. The inside of the panel

shall be painted with anti-condensation paint and shall be glossy white.

Oil, grease, dirt and swarf shall be thoroughly removed by emulsion cleaning.

Rust and scale shall be removed by pickling with dilute acid followed by washing with running water rinsing with a slightly alkaline hot water and drying.

After phosphating, thorough rinsing shall be carried out with clean water followed by final rinsing with dilute dichromate solution and oven drying.

The phosphate coating shall be sealed with application of two coats of ready mixed, stove zinc chromate primer. The first coat may be "flash dried" while the second coat shall be stoved.

After application of the primer, two coats of finishing synthetic enamel paint shall be applied, each coat followed by stoving. The second finishing coat shall be applied after inspection of first coat of painting. The exterior colour of paint shall be of a slightly different shade to enable inspection of the painting.

A small quantity of finished paint shall be supplied for minor touching up required at site after installation of the panels.

In case the bidder proposes to follow any other established painting procedure like electrostatic painting, the procedure shall be submitted for review.

7.0 NAME PLATES AND MARKINGS:

All equipment mounted on front and rear side as well as equipment mounted inside the panels shall be provided with individual name plates with equipment designation engraved. Also on the top of each panel on front as well as rear side, large and bold nameplates shall be provided for circuit/feeder designation.

All front mounted equipment shall also be provided at the rear with individual name plates engraved with tag numbers corresponding to the one shown in the panel internal wiring to facilitate easy tracing of the wiring.

Each instrument and meter shall be prominently marked with the quantity measured e.g. KV, A, MW, etc. All relays and other devices shall be clearly marked with manufacturer's name, manufacturer's type, serial number and electrical rating data.

Name Plates shall be made of non-rusting metal. Name plates shall be black with white engraving lettering.

Each switch shall bear clear inscription identifying its function e.g. 'BREAKER' '52A', "SYNCHRONISING" etc. Similar inscription shall also be provided on each device whose function is not other-wise identified. If any switch device does not bear this inscription separate name plate giving its function shall be provided for it. Switch shall also have clear inscription for each position indication e.g. "Trip- Neutral-Close", "ON-OFF", "R-Y-B-OFF" etc.

All the panels shall be provided with name plate mounted inside the panel bearing LOA No. date, Name of the Substation, feeder and reference drawing number.

8.0 MISCELLANEOUS ACCESSORIES:

Plug Point: 240V, Single phase 50Hz, AC socket with switch suitable to accept 5 Amps and 15 Amps pin round standard Indian plug, shall be provided in the interior of each cubicle with ON-OFF switch.

Interior Lighting: Each panel shall be provided with an 11W CFL lighting fixture including reflector front cover etc. rated for 240 Volts, single phase, 50 Hz supply for the interior illumination of the panel controlled by the respective panel door switch.

Switches and Fuses: No fuse shall be used, only MCB shall be used. Each panel shall be provided with necessary arrangements for receiving, distributing and isolating of DC and AC supplies for various control, signalling, lighting and space heater circuits. The incoming and sub-circuits shall be separately provided with miniature circuit breakers (MCB). Selection of the main and sub-circuit MCB rating shall be such as to ensure selective clearance of sub-circuit faults. MCBs shall conform to IS: 13947.

Each MCB shall be provided with one potential free contact and the same shall be wired for annunciation purpose.

Space Heater: Each panel shall be provided with a space heater rated for 240V, single phase, 50 Hz Ac supply for the internal heating of the panel to prevent condensation of moisture. The fittings shall be complete with switch unit.

9.0 EARTHING:

All panels shall be equipped with an earth bus securely fixed. Location of earth bus shall ensure no radiation interference for earth systems under various switching conditions of isolators and breakers. The material and the sizes of the bus bar shall be at least 25 X 6 sq.mm perforated copper with threaded holes at a gap of 50mm with a provision of bolts and nuts for connection with cable armours and mounted equipment etc. for effective earthing. When several panels are mounted adjoining each other, the earth bus shall be made continuous and necessary connectors and clamps for this purpose shall be included in the scope of supply of Supplier. Provision shall be made for extending the earth bus bars to future adjoining panels on either side.

Provision shall be made on each bus bar of the end panels for connecting Substation earthing grid. Necessary terminal clamps and connectors for this purpose shall be included in the scope of supply of Supplier.

All metallic cases of relays, instruments and other panel mounted equipment including gland plate, shall be connected to the earth bus by copper wires of size not less than 2.5 sq. mm. The colour code of earthing wires shall be green.

Looping of earth connections would result in loss of earth connection to other devices when the loop is broken, shall not be permitted. However, looping of earth connections between equipment to provide alternative paths to earth bus shall be provided.

VT and CT secondary neutral or common lead shall be earthed at one place only at the terminal blocks where they enter the panel. Such earthing shall be made through links so that earthing may be removed from one group without disturbing continuity of earthing system for other groups.

10.0 RELAYS:

All relays shall conform to the requirements of IS: 3231/IEC-60255 or other applicable standards. Relays shall be suitable for flush or semi-flush mounting on the front with connections from the rear.

All protective relays shall be of numerical type and communication protocol shall be as per IEC 61850. Further, the test levels of EMI as indicated in IEC 61850 shall be applicable to these relays.

All protective relays shall be in draw out or plug-in type/modular cases with proper testing facilities. Enough test sockets shall be provided for Relay secondary Injection test. Necessary test plugs/test handles shall be supplied loose and shall be included in supplier's scope of supply.

All AC operated relays shall be suitable for operation at 50 Hz. AC Voltage operated relays shall be suitable for 110 Volts VT secondary and current operated relays for 1 amp CT secondary. All DC operated relays and timers shall be designed for 220V DC voltage, and shall operate satisfactorily between 80% and 110% of rated voltage. Voltage Operated relays shall have adequate thermal capacity for continuous operation.

The protective relays shall be suitable for efficient and reliable operation of the protection scheme described in the specification. Necessary auxiliary relays and timers required for interlocking schemes for multiplying of contacts suiting contact duties of protective relays and monitoring of control supplies and circuits, lockout relay monitoring circuits etc. also required for the complete protection schemes described in the specification shall be provided. All protective relays shall be provided with at least two pairs of potential free isolated output contacts. Auxiliary relays and timers shall have pairs of contacts as required to complete the scheme; contacts shall be silver faced with spring action. Relay case shall have adequate number of terminals for making potential free external connections to the relay coils and contacts, including spare contacts.

All protective relays, auxiliary relays and timers except the lock out relays and interlocking relays specified shall be provided with self-reset type contacts. All protective relays and timers shall be provided with externally hand reset positive action operation indicators with inscription. All protective relays which do not have built-in hand-reset operation indicators shall have additional auxiliary relays with operating indicators (Flag relays) for this purpose. Similarly, separate operating indicator (auxiliary relays) shall also be provided in the trip circuits of protections located outside the board such as Buchholz relays, oil and winding temperature protection, sudden pressure devices, fire protection etc.

Timers shall be of the solid state type only. Time delay in terms of milliseconds obtained by the external capacitor resistor combination is not preferred and shall be avoided.

No control relay which shall trip the power circuit breaker when the relay is de-energised shall be employed in the circuits.

Provision shall be made for easy isolation of trip circuits of each relay for the purpose of testing and maintenance.

Auxiliary seal-in-units provided on the protective relays shall preferably be of shunt reinforcement type. If series relays are used the following shall be strictly ensured:

- a) The operating time of the series seal-in-unit shall be sufficiently shorter than that of the trip coil or trip relay in series with which it operates to ensure definite operation of the flag indicator of the relay.
- b) Seal-in-unit shall obtain adequate current for operation when one or more relays operate simultaneously.
- c) Impedance of the seal-in-unit shall be small enough to permit satisfactory operation of the trip coil on trip relays when the D.C. Supply Voltage is minimum.
- d) Trip-circuit seal-in is required for all trip outputs, irrespective of the magnitude of the interrupted current. The trip-circuit seal-in logic shall not only seal-in the trip output(s), but also the relevant initiation signals to other scheme functions, (e.g. initiate signals to the circuit-breaker failure function, reclosing function etc.), and the alarm output signals.
- e) Two methods of seal-in are required, one based on the measurement of AC current, catering for those circumstances for which the interrupted current is above a set threshold, and one based on a fixed time duration, catering for those circumstances for which the interrupted current is small (below the set threshold).
- f) For the current seal-in method, the seal-in shall be maintained until the circuit-breaker opens, at which time the seal-in shall reset and the seal-in method shall not now revert to the fixed time duration method. For this seal-in method, the seal-in shall be maintained for the set time duration. For the line protection schemes, this time duration shall be independently settable for single- and three-pole tripping.
- g) Seal-in by way of current or by way of the fixed duration timer shall occur irrespective of whether the trip command originates from within the main protection device itself (from any of the internal protection functions), or from an external device with its trip output routed through the main protection device for tripping. Trip-circuit seal-in shall not take place under sub-harmonic conditions (e.g. reactor ring down).

All protective relays and alarm relays shall be provided with one extra isolated pair of contacts wired to terminals exclusively for future use.

The setting ranges of the relays offered, if different from the ones specified shall also be acceptable if they meet the functional requirements.

Any alternative/additional protections or relays considered necessary for providing complete effective and reliable protection shall also be offered separately. The acceptance of this alternative/ additional equipment shall lie with the owner.

All relays and their drawings shall have phase indications as R-Red, Y-yellow, and B-blue

For numerical relays, the scope shall include the following:

- a) Necessary software and hardware to up/down load the data to/from the relay from/to the personal computer installed in the substation. The supply of PC is covered under scope of supply.
- b) The relay shall be capable of supporting IEC 61850 protocol.
- c) In case of line protection and transformer protection, the features like fault recorder and event logging function as available including available as optional feature in these relays shall be supplied and activated at no extra cost to the owner. Also necessary software/ hardware for automatic uploading to station HMI/DR work station (as applicable) shall be supplied.
- d) Ethernet Communication supporting IEC 61850 protocol shall be provided to connect IED of each panel. 50% spare port shall be kept as spare.

11.0 ANNUNCIATION SYSTEM:

Audible alarm shall be provided in order to draw the attention of the operator to the abnormal operating conditions or the operation of some protective devices. The annunciation shall be part of SAS system.

12.0 TRANSMISSION LINE PROTECTION:

The line protection relays are required to protect the line and clear the faults on line within shortest possible time with reliability, selectivity and full sensitivity to all type of faults on lines. The general concept is to have two main protections having equal performance requirement specifically in respect of time as called Main-I and Main-II for 220KV lines.

The length of lines and the line parameters (Electrical Constants) will be furnished by the owner.

The maximum fault current could be as high as 50 kA but the minimum fault current could be as low as 20% of rated current of CT secondary. The starting & measuring relays characteristics should be satisfactory under these extremely varying conditions.

The protective relays shall be suitable for use with 220KV GIS Voltage transformer having non-electronic damping and transient response as per IEC.

Disturbance Recorder, Distance to fault Locator and Over voltage relay (stage -1) functions if offered as an integral part of line protection relay, shall be acceptable provided these meet the technical requirements as specified in the respective clauses.

Auto reclose relay function if offered as an integral part of line distance protection relay. The auto reclose relay feature meets the technical requirements as specified in the respective clause.

The following protections shall be provided for each of the Transmission lines:

For 220KV:

Main-I: Numerical Line Differential & Distance protection scheme.

Main-II: Numerical Line distance protection scheme of a make different from that of Main –I.

The detailed description of the above line protections is given here under.

MAIN-I MAIN-II NUMERICAL DISTANCE PROTECTION SCHEME:

- a) Shall have continuous self-monitoring and diagnostic feature.
- b) Shall be non-switched type with separate measurements for all phase to phase and phase to ground faults.
- c) Shall have stepped time-distance characteristics and three independent zones (zone 1, zone-2 and zone-3).

- d) Shall have mho or quadrilateral or other suitably shaped characteristics for zone-1, zone-2 and zone- 3.
- e) Shall have following maximum operating time (including trip relay time, if any) under given set of conditions and with VT being used on line (with all filters included).

For 220 kV Lines:

Source to Impedance ratio:	15
Relay setting (Ohms)	2
Fault locations (as % of relay setting)	50
Fault Resistance (Ohms)	0
Maximum operating time (ms)	45 for 3 ph faults & 60 for all other faults

- f) The relay shall have an adjustable characteristics angle setting range of 30-85 degree or shall have independent resistance(R) and reactance (X) setting.
- g) Shall have two independent continuously variable time setting range of 0-3 seconds for zone-2 and 0-5 seconds for zone-3.
- h) Shall have resetting time of less than 55 milli-seconds (including the resetting time of trip relays).
- i) Shall have facilities for offset features with adjustable 10-20% of Zone-3 setting
- j) Shall have variable residual compensation
- k) Shall have memory circuits with defined characteristics in all three phases to ensure correct operation during close-up 3 phase faults and other adverse conditions and shall operate instantaneously when circuit breaker is closed to zero-volt 3 phase fault
- l) Shall have weak end in-feed feature
- m) Shall be suitable for single & three phase tripping
- n) Shall have a continuous current rating of two times of rated current. The voltage circuit shall be capable of operation at 1.2 times rated voltage. The relay shall also be capable of carrying a high short time current of 70 times rated current without damage for a period of 1 sec.
- o) Shall be provided with necessary self-reset type trip duty contacts for completion of the scheme (Minimum number of these trip duty contacts shall be four per phase) either through built in or through separate high speed trip relays. Making capacity of these trip contacts shall be 30 amp for 0.2 seconds with an inductive load of $L/R > 10$ mill seconds. If separate high speed trip relays are used, the operating time of the same shall not be more than 10 milliseconds
- p) Shall be suitable for use in permissive under reach/ over reach/ blocking communication mode
- q) Shall have suitable number of potential free contacts for Carrier aided Tripping, Auto reclosing, CB failure, Disturbance recorder & Data acquisition system
- r) Include power swing blocking protection which shall
- Have suitable setting range to encircle the distance protection described above
 - block tripping during power swing conditions
 - release blocking in the event of actual fault
- s) Include fuse failure protection which shall monitor all the three fuses of C.V.T. and associated cable against open circuit

- Inhibit trip circuits on operation and initiate annunciation
 - Have an operating time less than 7 milliseconds
 - remain inoperative for system earth faults
- t) Include a directional back up Inverse Definite Minimum Time (IDMT) earth fault relay with normal inverse characteristics as per IEC 60255-3 as a built in feature or as a separate unit.
- u) Must have a current reversal guard feature.

NUMERICAL LINE DIFFERENTIAL RELAY PROTECTION SCHEME:

- a) Longitudinal differential protection shall be based on current. It shall be numerical phase segregated type protection scheme (summation CT type scheme is not acceptable) for application at each end of the line. The protection shall be designed to detect all kinds of poly-phase and ground faults. It operation shall compare currents on a per phase basis.
- b) Loss or absence of potential does not affect current-based elements such as line current differential, over current and tapped-load protection.
- c) The protection shall be designed for fast operation and be suitable for protection of lines.
- d) The relays when applied at both ends of the line must operate simultaneously to clear a fault rapidly whether fault current is fed from one end or both.
- e) The relays should be designed to ensure time synchronization with the remote end relay when same model relay is between put in service at the remote end of the line with direct optic fibre connectivity of up to a distance as required for longer line at site for implementation of line protection. The relay must be compatible to operate with the remote end relay for implementation of line protection.
- f) The relay shall have display for indicating/display phase, differential and bias current magnitudes.
- g) The maximum operating time of the relay in respect of line differential protection shall be in acceptable limit.
- h) The relay shall have direct inter-trip/permissive inter-trip facilities selectable.
- i) The relay shall be equipped with Communication port (Dual channel when Main-1 only is line differential or Single channel when both Main-1 and main-2 relays are line differential relays) for line differential protection implementation wherein the communication interface in 87L relay shall be dependent on the communication link between the substations.
- j) Single mode IEEE 37.94 standard optical interface between relay and the FOPP/FODP.
- k) Multi-mode IEEE 37.94 standard optical interface between relay and the MUX. In case the MUX does not support the C37.94 optical interface other interface such as G.703 (Elec; 2Mbps) as available in the MUX shall be applicable.
- l) It shall be ensured that the relay interface is compatible in all respects such as wave length etc. Fibre optic patch cables with end connectors of sufficient length to connect the relay port to the fibre optic patch panel shall be provided for each relay. Exact length of this FO cable shall be ascertained at site, 1 set of FO patch cable is required as spare for each site.
- m) The relay shall have the built in distance protection functionality as specified for distance protection relay for line protection.
- n) All necessary wiring accessories, fibre optic cables to interface the line differential relay to the other end device (FOTP/OLTE) shall be provided with the relay whether the relay is supplied in a panel or in loose for remote end in substations.

BACK-UP DIRECTIONAL OVER CURRENT AND EARTH FAULT PROTECTION SCHEME:

- a) Shall have three over current and one earth fault element(s) which shall be either independent or composite unit(s)
- b) The scheme shall include necessary VT fuse failure relays for alarm purposes.
- c) Over current elements shall,
 - Have IDMT characteristic with a definite minimum time of 3.0 seconds at 10 times setting
 - Have a variable setting range of 50-200% of rated current
 - Have a characteristic angle of 30/45 degree lead
 - Include hand reset flag indicators or LEDs.
- d) Earth fault Element shall
 - Have IDMT characteristic with a definite minimum time of 3.0 seconds at 10 times setting
 - Have a variable setting range of 20-80% of rated current
 - Have a characteristic angle of 45/60 degree lag
 - Include hand reset flag indicators or LEDs
 - Include necessary separate interposing voltage transformers or have internal feature in the relay for open delta voltage to the relay.

LINE OVER VOLTAGE PROTECTION RELAY:

- a) Shall monitor all three phases
- b) Have two independent stages and stage- 1 & II. Relay as built in with line distance relays Main I & II respectively are acceptable.
- c) Have an adjustable setting range of 100-170% of rated voltage with an adjustable time delay range of 1 to 60 seconds for the first stage.
- d) Have an adjustable setting range of 100-170% of rated voltage with a time delay of 100-200 mill seconds for the second stage.
- e) Be tuned to power frequency
- f) Provided with separate operation indicators (flag target) for each stage relays.
- g) Have a drop-off to pick-up ratio greater than 95%.
- h) Provide separate out-put contacts for each 'Phase' and stage for breaker trip relays, event logger and other scheme requirements.

DISTANCE FAULT LOCATOR:

- a) Be microprocessor based type.
- b) Be 'On-line' type
- c) Be suitable for breaker operating time of 2 cycles
- d) Have built-in display unit
- e) The display shall be directly in percent of line length or kilometres without requiring any further calculations
- f) Have an accuracy of 3% or better for the typical conditions defined for operating timings measurement of distance relays.

- g) The above accuracy should not be impaired under the following conditions:
- Presence of remote end in feed
 - Predominant D.C. component in fault current
 - High fault arc resistance
 - Severe CVT transients
- h) Shall have mutual zero sequence compensation unit if fault locator is to be used on double circuit transmission line.
- i) Built in feature of line distance relay is acceptable provided the requirements of above clauses are met.

All trip relays used in transmission line protection scheme shall be of self/electrical reset type depending on application requirement.

13.0 CIRCUIT BREAKER PROTECTION:

This shall include following functions.

AUTO RECLOSING:

- a) Have single phase or/and three phase reclosing facilities.
- b) Have a continuously variable single phase dead time range of 0.1-2 seconds.
- c) Have a continuously variable reclaim time range of 5-300 seconds.
- d) Incorporate a two-position selector switch/ from which single phase/three phase auto reclosure and non-auto reclosure mode can be selected. Alternatively, the mode of auto reclosing can be selected through programming.
- e) Shall have facilities for selecting check synchronising or dead line charging features. It shall be possible at any time to change the required feature by reconnection of links
- f) Be of single shot type.
- g) Include check synchronising relay which shall have a time setting continuously variable between 0.5-5 seconds with a facility of additional 10 seconds.
- h) Have a response time within 200 milli seconds with the timer disconnected.
- i) Have a phase angle setting not exceeding 35 degree
- j) Have a voltage difference setting not exceeding 10%
- k) Include dead line charging relay which shall have two sets of relays and each set shall be able to monitor the three phase voltage where one set shall be connected to the line CVTs with a fixed setting of 20% of rated voltage and the other set shall be connected to the bus CVTs with a fixed setting of 80% of rated voltage.
- l) Incorporate necessary auxiliary relays and timers to give comprehensive scheme
- m) Auto-reclose as in built function of bay controller unit (BCU) provided for sub-station automation system is also acceptable for all voltages.

LOCAL BREAKER BACK-UP PROTECTION SCHEME:

- a) Be triple pole type

- b) Have an operating time of less than 15 milliseconds
- c) Have a resetting time of less than 15 milliseconds
- d) Have three over current elements
- e) Be arranged to get individual initiation from the corresponding phase of main protections of line for each over current element. However, common three phase initiation is acceptable for other protections and transformer /reactor equipment protections
- f) Have a setting range of 20-80% of rated current
- g) Have a continuous thermal withstand two times rated current irrespective of the setting
- h) Have a timer with continuously adjustable setting range of 0.1-1 seconds
- i) Have necessary auxiliary relays to make a comprehensive scheme.

14.0 TRANSFORMER PROTECTION:

All transformer protection functions shall grouped in to Group-I and Group –II protections in the following manner. Various functions as built – in function of Group-I/II shall be accepted only if functional requirements of corresponding protections as specified in clause 14.1 to 14.5 are met otherwise separate relays shall be provided.

Group-I Protection:

- a. Differential Protection as per Clause 14.1
- b. Over Fluxing Protection for HV side as per Clause 14.2
- c. Directional over current and earth fault protection for HV side as per Clause 14.4
- d. Over load protection as per Clause 14.5

Group –II Protection:

- a. REF Protection as per Clause 14.3
- b. Directional over current and earth fault protection for LV sides as per Clause 14.4
- c. Directional over current and earth fault protection for HV & LV side as per Clause 14.4

14.1 TRANSFORMER DIFFERENTIAL PROTECTION:

- a) Be triple pole type, with faulty phase identification/ indication.
- b) Have an operating time not greater than 30 milliseconds at 5 times the rated current.
- c) Have three instantaneous high set over-current units
- d) Have an adjustable bias setting range of 20-50%
- e) Be suitable for rated current of 1 Amp.
- f) Have second harmonic or other inrush proof features and also should be stable under normal over fluxing conditions. Magnetising inrush proof feature shall not be achieved through any intentional time delay e.g. use of timers to block relay operation or using disc operated relays.
- g) Have an operating current setting of 15% or less.
- h) Include necessary separate interposing current transformers for angle and ratio correction or have internal feature in the relay to take care of the angle & ratio correction.

- i) Have a fault recording feature to record graphic form of instantaneous values of current in all three windings in 6 analogue channels during faults and disturbances for the pre fault and post fault period and voltage in one channel. The disturbance recorder shall have the facility to record the following external digital channel signals apart from the digital signals pertaining to differential relay:
1. REF protection operated
 2. HV breaker status
 3. LV breaker status
 4. Buchholz /OLTC Buchholz alarm / trip
 5. WTI/OTI/PRD alarm/trip of transformer

Necessary hardware and software for down loading the data captured by disturbance recorder to the personal computer available in the substation shall be included in the scope.

14.2 OVER FLUXING PROTECTION RELAYS:

- a) Operate on the principle of Voltage to frequency ratio and shall be phase to phase connected. Have inverse time characteristics, matching with transformer over fluxing withstand capability curve provide an independent 'alarm' with the time delay continuously adjustable between 0.1 to 6.0 seconds at values of 'v/f' between 100% to 130% of rated values tripping time shall be governed by 'v/f' Vs. time characteristics of the relay
- b) Have a set of characteristics for various time multiplier settings. The maximum operating time of the relay shall not exceed 3 seconds and 1.5 seconds at 'v/f' values of 1.4 and 1.5 times, the rated values, respectively.
- c) Have an accuracy of operating time, better than $\pm 10\%$.
- d) Have a resetting ratio of 95 % or better.
- e) Be inbuilt in main protection.

14.3 RESTRICTED EARTH FAULT PROTECTION:

- a) Be single pole Low impedance type
- b) Be of current/voltage operated type
- c) Have a current setting range of 10-40% of 1 Amp.
- d) Be tuned to the system frequency
- e) Be inbuilt in main protection.

14.4 BACK-UP DIRECTIONAL OVER CURRENT AND EARTH FAULT PROTECTION SCHEME WITH HIGH SET FEATURE:

- a) Shall have three over current and one earth fault element(s) which shall be either independent or composite unit(s).
- b) The scheme shall include necessary VT fuse failure relays for alarm purpose.
- c) Over current relay shall
 - Have directional IDMT characteristic with a definite minimum time of 3.0 seconds at 10 times setting and have a variable setting range of 50-200% of rated current.
 - Have low transient, over reach high set instantaneous unit of continuously variable setting range 500-2000% of rated current.
 - Have a characteristic angle of 30/45 degree lead.

- Include hand reset flag indicators or LEDs.
- d) Earth fault relay shall
 - Have directional IDMT characteristic with a definite minimum time of 3.0 seconds at 10 times setting and have a variable setting range of 20-80% of rated current
 - Have low transient, over reach high set instantaneous unit of continuously variable setting range 200-800 % of rated current
 - Have a characteristic angle of 45/60 degree lag
 - Include hand reset flag indicators or LEDs
 - Include necessary separate interposing voltage transformers or have internal feature in the relay for open delta voltage to the relay

14.5 TRANSFORMER OVERLOAD PROTECTION RELAY:

- a) Be of single pole type.
- b) Be of definite time over-current type and built in feature with differential relay shall also be acceptable.
- c) Have one set of over-current relay element, with continuously adjustable setting range of 50-200% of rated current.
- d) Have one adjustable time delay relay for alarm having setting range of 1 to 10.0 seconds, continuously.
- e) Have a drop-off/pick-up ratio greater than 95%.
- f) Shall be part of Differential relay.

Further protection contacts (Buchholz, PRV, oil temperature, winding temperature, OLTC Buchholz etc.) can be wired suitably in the above protection or provide separate flag/auxiliary relay as per scheme requirement.

15.0 TRIPPING RELAY:

High Speed Tripping Relay shall

- a) Be instantaneous (operating time not to exceed 10 milliseconds).
- b) Reset within 20 milliseconds.
- c) D.C Operated.
- d) Have adequate contacts to meet the requirement of scheme, other functions like auto-reclose relay, LBB relay as well as cater to associated equipment like event logger, Disturbance recorder, fault Locator, etc.
- e) Be provided with operation indicators for each element/coil.

16.0 TRIP CIRCUIT SUPERVISION RELAY:

- a) The relay shall be capable of monitoring the healthiness of each 'phase' trip-coil and associated circuit of circuit breaker during 'ON' and 'OFF' conditions.
- b) The relay shall have adequate contacts for providing connection to alarm and event logger.
- c) The relay shall have time delay on drop-off of not less than 200 milliseconds and be provided with operation indications for each phase.

17.0 DC SUPPLY SUPERVISION RELAY:

- a) The relay shall be capable of monitoring the failure of D.C. supply to which, it is connected.

- b) It shall have adequate potential free contacts to meet the scheme requirement.
- c) The relay shall have a 'time delay on drop-off' of not less than 100 milliseconds and be provided with operation indicator/flag.

18.0 BUS BAR PROTECTION:

Bus Bar protection scheme suitable for Double Bus shall be provided for 220kV system.

Bidder may offer Centralised bus bar protection scheme.

Each Bus Bar protection scheme shall

- a) Have maximum operating time up to trip impulse to trip relay for all types of faults of 25 milliseconds at 5 times setting value.
- b) Operate selectively for each bus bar
- c) Give hundred percent security up to 50 kA fault level for 220kV and incorporate continuous supervision for CT secondary against any possible open circuit and if it occurs, shall render the relevant zone of protection inoperative and initiate an alarm
- d) Not give false operation during normal load flow in bus bars.
- e) Incorporate clear zone indication.
- f) Be of phase segregated and triple pole type
- g) Provide independent zones of protection.
- h) Include individual high speed electrically reset tripping relays for each feeder. However, in case of distributed Bus bar protection, individual trip relay shall not be required if bay unit is having trip duty contacts for breaker tripping.
- i) Be transient free in operation.
- j) Include continuous D.C. supplies supervision.
- k) Not cause tripping for the differential current below the load current of heaviest loaded feeder. Successful Agency shall submit application check for the same.
- l) Shall include necessary C.T. switching relays wherever C.T. switching is involved and have 'CT selection incomplete' alarm.
- m) Include protection 'IN/OUT' switch for each zone.
- n) Shall include trip relays, CT switching relays (if applicable), auxiliary CTs (if applicable) as well as additional power supply modules, input modules etc. as may be required to provide a Bus-bar protection scheme for the complete bus arrangement i.e. for all the bay or breakers under this specification as well as for the future bays as per the Single line diagram. Suitable panels to mount these are also included in the scope of the work.
- o) In case of distributed bus bar protection, the bay units for future bays may be installed in a separate panel and the same shall be located in the GIS local panel room where the bus bar protection panel shall be installed.
- p) Built-in Local Breaker Backup protection feature as a part of bus bar protection scheme shall also be acceptable.
- q) The test terminal blocks (TTB) to be provided shall be fully enclosed with removable covers and made of moulded, non-inflammable plastic material with boxes and barriers moulded integrally. All terminals shall be clearly marked with identification numbers or letters to facilitate connection to external wiring.

Terminal block shall have shorting, disconnecting and testing facilities for CT circuits.

19.0 33kV TWIN FEEDER PROTECTION PANEL FOR LINE:

The 33kV Twin feeder protection panel for line shall comprise of the following

S.NO	DESCRIPTION	33kV
1.	Bay control and protection unit (BCPU)	✓
2.	3 phase trip relays	✓
3.	Flag relays, Aux. Relay, timers, trip relays as per scheme requirements	✓
4.	Energy meter	✓

33kV FEEDER PROTECTION PANEL FOR STATION TRANSFORMER

The 33kV Twin feeder protection panel for Station transformer shall comprise of the following

S.NO	DESCRIPTION	33kV
1.	Bay control and protection unit (BCPU)	✓
2.	3 phase trip relays	✓
3.	Flag relays, Aux. Relay, timers, trip relays as per scheme requirements	✓
4.	Energy meter	✓

20.0 DISTURBANCE RECORDER:(Inbuilt feature of IED shall be acceptable):

Disturbance Recorder shall be Microprocessor based and shall be used to record the Graphic Form of Instantaneous Values of Voltages and Current in all three Phases, Open Delta Voltage and Neutral Current, Open or Closed Position of Relay Contacts and Breakers during the System Disturbances. Built in Feature of Line Distance Relay, Transformer, and Bus Bar Protection is acceptable provided the requirements of following Clauses are met.

Disturbance Recorder shall consist of Individual Acquisition Units, one for each Feeder and an Evaluation Unit, which is common for the entire Sub Station. Whenever more than One Acquisition Units are connected to an Evaluation Unit, necessary Hardware, and Software shall also be supplied for On - Line Transfer of Data from all Acquisition Units to Evaluation Unit. The Acquisition Units shall communicate with the evaluation unit through LAN to enable high - speed data transmission through Bus conforming to IEC: 61850. If there are any constraints for one Evaluation Unit to accept the Data from number of Acquisition Units under the present scope, adequate number of Evaluation Units shall be supplied. For extension of existing Sub Station(s), One Set of Evaluation Unit shall be supplied for each Sub Station wherever Disturbance Recorders are specified.

For extension of existing Sub Station(s), which are without Sub Station Automation System, one set of Evaluation Unit shall be supplied for each Sub Station wherever Disturbance Recorders are required to be

supplied along with necessary evaluation software as specified above.

Disturbance Recorder shall have 8 Analogue and 16 Digital Channels for each Feeder / Transformer / Bus Bar. Acquisition Units shall acquire the Fault Data for the Pre Fault and Post Fault period and transfer them to Evaluation Unit automatically to store in the Hard Disk. The Acquisition Units shall be located in the Protection Panels of the respective Feeders.

The Acquisition Unit shall be suitable for Inputs from the Current Transformers with 1 Ampere Rated Secondary and Capacitive Voltage Transformers with 63.5 Volt (Phase to Neutral Voltage) Rated Secondary. Any Device required for processing of Input Signals in order to make the signals compatible to the Disturbance Recorder, Equipment shall form an Integral part of it. However, such processing of Input Signals shall in no way distort its waveform.

The Equipment shall be carefully screened, shielded, earthed, and protected as may be required for its safe functioning. Also, the Disturbance Recorder shall have stable Software, reliable Hardware, simplicity of Maintenance and immunity from the effects of the hostile environment of EHV Switchyard, which are prone to various interference signals typically from large Switching Transients.

The Evaluation Unit shall consist of a Desktop Personal Computer (including 17" TFT Monitor, Mouse, and Keyboard) and Printer. The Desktop Personal Computer shall have latest processor and having a clock speeds 4 GHz or better. The Hard Disk Capacity of PC shall not be less than 500 GB and RAM Capacity shall not be less than 10 GB.

Necessary Software for Transferring the Data Automatically from Local Evaluation Unit to a Remote Station and Receiving the same at the Remote Station through Owner's PLCC / VSAT / LEASED LINE shall be provided.

Evaluation Software shall be provided for the Analysis and Evaluation of the recorded Data made available in the PC under WINDOWS environment. The Software Features shall include repositioning of Analogue and Digital Signals, Selection and Amplification of Time and Amplitude Scales of each Analogue and Digital Channel, Calculation of MAX. / MIN. Frequency, Phase Difference Values, recording of MAX. / MIN. Values etc of Analogue Channel, group of Signal to be drawn on the same axis etc, listing and numbering of all Analogue and Digital Channels and Current, Voltage, Frequency and Phase Difference Values at the time of Fault / Tripping. Also, the Software should be capable of carrying out Fourier / Harmonic Analysis of the Current and Voltage Wave Forms. The Disturbance Recorder shall have a facility to Transfer the Analogue Values during Pre – Fault, during Fault and Post Fault and Time taken for each Digital value activated after Fault occurred. It shall have a facility to calculate the Fault Locator and Transfer the Data. The Disturbance Records shall also be available in COMTRADE Format (IEEE Standard – Common Format for Transient Data Exchange for Power System).

The Evaluation Unit shall be connected to the Printer to obtain the Graphic Form of disturbances whenever desired by the Operator.

Disturbance Recorder Acquisition Units shall be suitable to operate from 220 Volt DC Supply as available at Sub Station. Evaluation Unit along with the Printer shall normally be connected to 230 Volt, Single Phase AC Supply. In case of failure of AC Supply, Evaluation Unit and Printer shall be switched automatically to the Station DC through Inverter of adequate Capacity, which shall form a part of Disturbance Recorder System.

The Inverter of adequate capacity shall be provided to cater the requirement specified in Section Sub Station Automation and DR Evaluation Unit.

The Acquisition Unit shall have the following Features: -

- a) Facility shall exist to Alarm Operator in case of any Internal Faults in the Acquisition Units such as Power Supply Fail, Processor, / Memory Fail etc and it shall be wired to Annunciation System.
- b) The Frequency response shall be 5 Hz on Lower Side and 250 Hz or better on upper side.
- c) Scan Rate shall be 1,000 Hz / Channel or better.
- d) Pre Fault Time shall not be less than 100 milliseconds and the Post Fault Time shall not be less than 2 seconds (adjustable). If another System Disturbance occurs during one Post Fault Run Time, the Recorder shall also be able to record the same. However, the Total Memory of Acquisition Unit shall not be less than 40 seconds, and it can store minimum 8 numbers Records.
- e) The Open Delta Voltage and Neutral Current shall be derived through either Software or externally providing necessary Auxiliary Transformers.
- f) The Acquisition Unit shall be Typically used to Record the following Digital Channels: -

IN CASE OF LINE:

1. Main Circuit Breaker – R Phase OPEN.
2. Main Circuit Breaker – Y Phase OPEN.
3. Main Circuit Breaker – B Phase OPEN.
4. Main – I Carrier Received.
5. Main – I Protection Operated.
6. Main / TBC Auto Reclosed Operated
7. Over Voltage – Stage – 1 / 2 Operated.
8. TEE -1 / TEE – 2 / U. F. Protection Operated.
9. Direct Trip Received.
10. Main – II Carrier Received.
11. Main – II / Back up Protection Operated.
12. Bus Bar Protection Operated.
13. LBB Operated of Main Circuit Breaker.
14. TBC CB R Phase Open
15. TBC CB Y Phase Open
16. TBC CB C Phase Open
17. df / dt Relay Operated

IN CASE OF TRANSFORMER:

1. HV Main Circuit Breaker – R Phase OPEN.
2. HV Main Circuit Breaker – Y Phase OPEN.
3. HV Main Circuit Breaker – B Phase OPEN.

4. LV Main Circuit Breaker – R Phase OPEN.
 5. LV Main Circuit Breaker – Y Phase OPEN.
 6. LV Main Circuit Breaker – B Phase OPEN.
 7. Differential Relay Operated.
 8. O/C and E/F Protection Operated.
 9. HV Over Flux Operated.
 10. LV Over Flux Operated.
 11. Bus Bar Protection Operated.
 12. LBB Protection Operated.
 13. REF Protection Operated.
 14. Oil temperature High Operated.
 15. Winding Temperature High Operated.
 16. Buchholz Main Tripped
 17. OLTC Tripped.
 18. PRD 1 / 2 Trip
 19. TBC CB R Phase Open
 20. TBC CB Y Phase Open
 21. TBC CB C Phase Open
- g) If offered as in - built Feature of Line Distance Relays, it should be quoted for both Main – I and Main – II (for 100 % redundancy). Similarly, for Transformer (87 T) and for BUS BAR.
- h) In case the Disturbance Recorder is In - Built Part of Bay Protection Unit, above Digital Channels may be interfaced either externally or internally.
- i) Any Digital Signal can be programmed to act as Trigger for the Acquisition Unit. Analogue Channels should have programmable Threshold Levels for triggers and Selection for over or under levels should be possible.

The Colour Laser Printer shall be compatible with the Desktop PC and shall use Plain Paper. The Print Out shall contain the Feeder Identity, Date and Time (in Hour, Minute and Second up to 100th of a second), Identity of Trigger Source and Graphic Form of Analogue and Digital Signals of all the Channels. Ten Packets of A4 size Paper (500 Sheets in each Packet) suitable for Printer shall be supplied.

Each Disturbance Recorder shall have its own Time Generator and the Clock of the Time. Generator shall be such that the Drift is limited to ± 0.5 seconds/ day, if allowed to run without synchronisation. Further, Disturbance Recorder shall have facility to synchronise its Time Generator from Time Synchronisation Equipment having Output of following Types:

- Voltage Signal: 0 – 5 V Continuously Settable, with 50 msec. Minimum Pulse Duration.
- Potential Free Contact having Minimum Pulse duration of 50 msec.

- IRIG – B
- RS232C
- RS - 485

The Disturbance Recorder shall give Annunciation in case of absence of Synchronising Pulse within a specified Time.

Sub-Stations where Time Synchronisation Equipment is not available, Time Generator of any one of the Disturbance Recorders can be taken as MASTER and Time Generators of other Disturbance Recorders and Event Loggers in that Station shall be synchronised to follow the MASTER.

The Disturbance Recorder shall be capable of being triggered by the following user specified Quantities:-

- a) External start, both Software and Hardware
- b) Cross triggering of Groups of Channels, either Software or Hardware or both
- c) Binary Channel (NO and NC Contacts)
- d) Over Voltage and Under Voltage
- e) Over Current
- f) Negative Sequence Voltage
- g) Zero Sequence Voltage
- h) Over Frequency / Under Frequency
- i) Logical or Boolean Expressions, Programmable
- j) Power Swing

The Transformer Relay Panel shall have a Disturbance Recording Feature to record Graphic Form of instantaneous Values of Current in all Three Windings in Six Analogue Channels during Fault and Disturbances for Pre Fault and Post Fault Period. Over and above, it should have at least 4 Voltage Channels. The Disturbance Recorders shall have the facility to record the following external Digital Channel signals apart from the Digital Signals pertaining to Differential Relay: -

1. 87 Protection Operated
2. HV Breaker Status
3. LV Breaker Status
4. Buchholz / OLTC Alarm / Trip
5. WTI / OTI / PRD Alarm / Trip of Transformer

Necessary Hardware and Software for down loading the Data captured by Disturbance Recorder to the Personal Computer available in the Sub Station shall be included in the Scope of this Tender.

21.0 TIME SYNCHRONISATION EQUIPMENT:

The Time synchronisation equipment shall receive the co-ordinated Universal Time (UTC) transmitted through Geo Positioning Satellite System (GPS) and synchronise equipment to the Indian Standard Time in a substation.

Time synchronisation equipment shall include antenna, all special cables and processing equipment etc.

It shall be compatible for synchronisation of Event Loggers, Disturbance recorders and SCADA at a substation.

Equipment shall operate up to the ambient temperature of 50 degree centigrade and 100% humidity.

The synchronisation equipment shall have 2 microsecond accuracy. Equipment shall give real time corresponding to IST (taking into consideration all factors like voltage, & temperature variations, propagation & processing delays etc).

Equipment shall meet the requirement of IEC 60255 for storage & operation.

The system shall be able to track the satellites to ensure no interruption of synchronisation signal.

The output signal from each port shall be programmable at site for either one hour, half hour, minute or second pulse, as per requirement.

The equipment offered shall have six (6) output ports. Various combinations of output ports shall be selected by the customer, during detailed engineering, from the following:

- SNTP Port
- Potential free contact (Minimum pulse duration of 50 milliseconds.)
- IRIG-B
- RS232C

The equipment shall have a periodic time correction facility of one second periodicity.

Time synchronisation equipment shall be suitable to operate from 220V DC or 110V DC as available at Substation.

Equipment shall have real time digital display in hour, minute, second (24 hour mode) & have a separate time display unit to be mounted on the top of control panels having display size of approx. 100 mm height.

22.0 TYPE TESTS:

The reports for following type tests shall be submitted by the successful Agency for the Protective relays, Fault locator and Fault recorder.

- a) Insulation tests as per IEC 60255-5
- b) DC Voltage dips and interruptions/Variation as per IEC 6100-4-29.
- c) High frequency disturbance test as per IEC 60255-4 -16 -Class IV
- d) Electrostatic discharges as per IEC 61000-4-2, level-IV
- e) Fast transient test as per IEC 61000-4, Level IV.
- f) Relay characteristics, performance and accuracy test as per IEC 60255
 - Steady state Characteristics and operating time
 - Dynamic Characteristics and operating time for distance protection relays and current differential protection relays
 - Conformance test as per IEC 61850-10
 - For Fault recorder only performance tests are intended under this item.
- g) Tests for thermal and mechanical requirements as per IEC 60255-6
- h) Tests for rated burden as per IEC 60255-6
- i) Contact performance test as per IEC 60255-0-20 (not applicable for Event logger, Distance to fault locator and Disturbance recorder)
- j) In case there is a change either in version or in model (Except firmware) of the relay, the supplier has to submit the type test reports for the offered revision/model.

Steady state & Dynamic characteristics test reports on the distance protection relays, as type test, shall be conducted on simulator/network analyser/PTL. Alternatively, the files generated using Electromagnetic transient Programme (EMTP) can also be used for carrying out the above tests. Single source dynamic tests on transformer differential relay shall be/ should have been conducted based on general guidelines specified in CIGRE committee 34 reports on Evaluation of characteristics and performance of Power system protection relays and protective systems.

23.0 CONFIGURATION OF PROTECTION PANELS:

The supplier can optimise the requirement of panels by suitably clubbing the feeder protection and CB relay panels. It may be noted that Main-I and Main-II protections for line cannot be provided in single panel. Similarly, HV & LV protections for transformer cannot be provided in single panel. The following is the general criteria for the selection of the equipment to be provided in each type of panel.

22.1 LINE PROTECTION PANEL:

The line protection panel relays for transmission lines shall consist of following protection schemes.

S.NO	DESCRIPTION	220KV
1.	Main-I Numerical Differential /Distance Protection	✓
2.	Main-II Distance protection relay	✓
3.	Over Voltage Protection	✓
4.	Disturbance Recorder (Inbuilt in Main relay)	✓
5.	Fault Locator(Inbuilt in Main relay)	✓
6.	3 phase Trip relays	✓
7.	Flag relays, Carrier receive relays, Auxiliary relays, Timers etc as per scheme requirement	✓
8.	Under Voltage protection relay for isolator/Earth switch	✓
9.	Directional back up Over current and Earth fault protection	✓
10.	Bay control unit	✓

22.2 TRANSFORMER PROTECTION PANEL:

The protection panel for Power transformer shall consists of the following features/ scheme

S.NO	DESCRIPTION	HV SIDE	LV SIDE
1.	Transformer Differential Protection	✓	
2.	Restricted Earth fault protection	✓	✓
3.	Directional back up O/C and E/F relay with Non directional high set feature	✓	✓
4.	Over fluxing protection	✓	
5.	Over load protection	✓	
6.	3 phase trip relays	✓	✓
7.	VT selection relays as per scheme requirement	✓	✓
8.	Bay Control unit	✓	
9.	BCU with DOC/DEF protection unit- 33kV		✓

10.	Flag relays, Carrier receive relays, Aux. relays, Timers etc as per scheme requirement	✓	✓
11.	Disturbance Recorder (Inbuilt in Main relay)	✓	✓

22.3 BUS COUPLER PROTECTION PANEL:

The Bus coupler protection panel shall comprise of the following:

S.NO	DESCRIPTION	220Kv
1.	IDMT over current and earth fault protection	✓
2.	3 phase trip relays	✓
3.	Flag relays, Aux. Relay, timers, trip relays as per scheme requirements	✓
4.	Bay Control unit	✓

22.4 220kV BUS BAR PROTECTION PANEL:

The Bus bar protection panel shall comprise of the following:

S.NO	DESCRIPTION	220kV
1.	Bus Bar differential relay	✓
2.	Flag relays, Aux. Relay, timers, trip relays as per scheme requirements	✓

24.0 ERECTION AND MAINTENANCE TOOL EQUIPMENTS:

All special testing equipment required for the installation and maintenance of the apparatus, instruments devices shall be furnished in relevant schedule.

25.0 TROPICALISATION:

Control room will not be normally air-cooled/air- conditioned. All equipments shall however be suitable for installation in a tropical monsoon area having hot, humid climate and dry and dusty seasons with ambient conditions specified in the specification. All control wiring, equipment and accessories shall be protected against fungus growth, condensation, vermin and other harmful effects due to tropical environment.

26.0 SCHEDULE OF QUANTITY

S.No	Item Description	Unit	Qty
1	220kV Line Protection panel (each)	Set	1
2	220kV Transformer Protection HV & LV	Sets	2
3	220kV Bus Coupler Protection panel	Set	1
4	220kV Bus bar Protection panel	Set	1
5	33kV Twin Feeder Panel for Line feeders	Sets	1
6	33kV TBC panel	Set	1
7	33kV twin feeder Panel for Station trafo.	Set	1

PART-5

SUBSTAION AUTOMATION SYSTEM (SAS)

TECHNICAL SPECIFICATION FOR SUB-STATION AUTOMATION

The Substation Automation System (SAS) is proposed for Grid sub-station with installation of Bay control Unit in relay panels, work station (Main & standby), Engineering Station, HMI, Large video screen of minimum 67 inches (2x2 matrix) (as specified in relevant clause below), printers and remote transmission unit for Remote Network Control center & SLDC.

The Substation Automation System (SAS) shall be installed to control and monitor all the sub-station equipment from remote control center (RCC) as well as from local control center.

The SAS shall contain the following main functional parts:

- i. Bay control Intelligence Electronic Devices (IEDs) for control and monitoring.
- ii. Station Human Machine Interface (HMI)
- iii. Redundant managed switched Ethernet Local Area Network communication infrastructure.
- iv. Peripheral equipment like printers, display units, key boards, Mouse etc.
- v. Remote HMI (Remote Control center)

It shall include communication gateway, intelligent electronic devices (IED) for bay control and inter IED communication infrastructure.

The communication gateway shall facilitate the information flow to remote control centres & Load despatch Centre. The bay level intelligent electronic devices (IED) for protection and control shall provide the direct connection to the switchgear without the need of interposing components and perform control, protection, and monitoring functions.

The substation switchyard configuration is provided in attached Single Line diagrams. The BCP (for 33 kV side only) is to be installed in the relay panels. The substations are equipped with latest IEC61850 Edition 2 & PRP compliant numerical protection relays. The protection arrangements for the different voltage system for SAS of GSSs should be as envisaged below.

1. 220 kV Side: (Two Main bus arrangement):

- i. **Line bay:** The line bay shall have one Bay controller Unit (BCU), two distance protection, one backup directional over Current & earth fault relay. The CR panels are having 'IEC61850 Edition 2' & PRP complied numerical distance, over current & earth fault protection relays and electro mechanical trip & auxiliary relays as per the technical specification. The vendor needs to provide 'IEC61850 Edition 2' & PRP compliant Bay Control unit & necessary auxiliary relays. The trip circuit supervision, electrical reset of the tripping relays & carrier supervision function will be performed by Bay Controller Unit.

ii. Transformer bay: The transformer bay shall have Bay controller Unit(BCU), One (for 220/33KV) differential protection, dedicated REF protection and one backup directional over Current & earth fault relay. The CR panels should have ‘IEC61850 Edition 2’ & PRP complied numerical differential, Numerical REF, over current & earth fault protection relays and electro mechanical trip & auxiliary relays as per the technical specification. The vendor needs to provide ‘IEC61850 Edition 2 & PRP compliant Bay Control unit & necessary auxiliary relays. The trip circuit supervision, electrical reset of the tripping relays & Automatic voltage regulation function will be performed by Bay Controller Unit.

iii. Bus Coupler bay: Each bay shall have Bay controller Unit (BCU), backup over Current & earth fault relay. The CR panels should have ‘IEC61850 Edition 2’ & PRP complied numerical over current & earth fault protection relays and electro mechanical trip & auxiliary relays as per the technical specification. The vendor needs to provide ‘IEC61850 Edition 2’ & PRP compliant Bay Control unit & necessary auxiliary relays. The trip circuit supervision, electrical reset of the tripping relays & station DC regulation function will be performed by Bay Controller Unit.

Note: Dedicated Bus-Bar protection for 220 KV systems, which shall also to be connected to SAS.

2. 33kV Side:

Each bay shall be provided with on Bay controller & protection Unit (BCPU). The unit should be capable of protection, measurement, and control & record and shall have ‘IEC61850 Edition 2’ & PRP protocols for full system integration. The BCPU should be capable of following feeder protection functions.

- i. Current protection (50/50N,51/51N,67/67N & 64/59N),
- ii. Voltage protection (59, 27).
- iii. Frequency protection (81 U, 81O,81R)
- iv. Power & Power factor protection (32,55)

Additional Multifunction meter may be provided for monitoring the measurement, if monitoring of measurement is not available in BCPU.

QUALIFYING REQUIREMENT FOR SUPPLY INSTALLATION & COMMISSIONING OF THE SUBSTATION AUTOMATION SYSTEM:

The SAS shall be sourced from Original Equipment Manufacturer (OEM). SCADA Software must belong to OEM itself and other out-sourced or 3rd party SCADA software are not accepted. The offered equipment have to be designed, manufactured and tested as per relevant IS/IEC with latest amendments. The bidder/ Manufacturer should have installed/retrofitted & commissioned the system with trouble free operation for minimum three years in any of the power system utilities in India. Further, the

bidder/ Manufacturer should fulfil the following criteria & supporting documents to the effect should be accompanied with the tender document.

- 1) The minimum requirement of manufacturing capacity of offered type, size and rating of equipment shall be FIVE times tender/ bid quantity per annum. The bidder/ Manufacturer should indicate manufacturing capacity by submitting latest updated certificate of a Chartered Engineer (CE).
- 2) The Substation Automation system shall be offered from a manufacturer who must have designed, manufactured, tested, installed and commissioned substation automation system which must be in satisfactory operation on 220/33KV system in India for at least 3 (Three) years as on the date of bid opening.
- 3) The bidder should furnish performance report of SAS system supplied installed and commissioned by them/ Manufacturer indicating the quantity and Single Value Contract executed during last FIVE (5) years, for the offered equipment. The details are to be submitted in following format,

Sl.No	Name of the Utility	Order No.& Date	Items supplied With quantity & work done.	Date of Completion	If completed Within Stipulated Period.	Performance of the System as on date.	Remark

- 4) Equipment offered shall have Type Test Certificates from accredited laboratory (accredited based on ISO/IEC Guide 25 / 17025 or EN 45001 by the National accreditation body of the country where laboratory is located), as per IEC / IS / technical specification.

SPECIFICATION:

I. SCOPE:

The Substation Automation System (S.A.S) for EHV substations is to be used for the control, protection and supervision of new Air insulated (AIS)/ Gas insulated (GIS) EHV substations of different voltage levels of OPTCL.

This specification covers technical, functional, configuration and testing requirements for a substation automation system for extra high voltage (EHV) substation.

The substation automation system shall be digital and shall include control, protection, monitoring, measurement functions and tele-transmission of data and commands.

II. STANDARDS:

The substation automation solutions should be future proof & compliant to international standards of latest IEC 61850, and simplify maintenance and enable interoperability.

The standards applicable for this automated digital control, protection system & communication protocol for the EHV sub- station are as follows.

1. 'IEC61850 Edition 2'.
 - i. IEC 61850-8-1, information is exchanged as GOOSE messages.
2. IEC 60870 set of standards which define systems used for tele-control (supervisory control and data acquisition) in electrical engineering and power system automation.
 - i. IEC 60870-5-1 Transmission Frame Formats
 - ii. IEC 60870-5-3 General Structure of Application Data
 - iii. IEC 60870-5-4 Definition and Coding of Information Elements
 - iv. IEC 60870-5-5 Basic Application Functions
 - v. IEC 60870-5-6 Guidelines for conformance testing for the IEC 60870-5.

Also following companion standards may be referred during the design, which shall be applicable for basic tele-control tasks, transmission of integrated totals, and data exchange from protection equipment & network access of IEC101/104 respectively.

- IEC 60870-5-101 Transmission Protocols, companion standards especially for basic tele-control tasks
- IEC 60870-5-102 Companion standard for the transmission of integrated totals in electric power systems (this standard is not widely used)
- IEC 60870-5-103 Transmission Protocols, Companion standard for the informative interface of protection equipment
- IEC 60870-5-104 Transmission Protocols, Network access for IEC 60870-5-101 using standard transport profiles

III. CLIMATIC CONDITIONS:

This automated digital control and protection system for EHV substations, shall be capable of withstanding the following climatic conditions:

- i. Ambient temperature during operation : -5 °C to +55°C

- ii. Ambient temperature during storage : -5 °C to +55°C
- iii. Relative humidity : 5% - 90%
- iv. Altitude level:

IV. SUPPORT DOCUMENTS:

This substation automation system for EHV substation shall be designed for AIS/GIS substation of OPTCL with the instructions contained in this technical specification and with the information provided in the following documents approved by OPTCL for the turnkey contract.

- a. EHV substation single line diagram
- b. EHV substation layout drawing in which the following are depicted:
 - Location of EHV substation primary equipment
 - EHV substation's control building
- c. Switchgear interlocking arrangements.
- d. List of commands to the substation equipment.
- e. List of digital event and alarm signals for this hereby substation automation system.
- f. List of analogue measurements for this thereby substation automation system
- g. List of commands received from transmission's system Remote control center (RCC) and if applicable from the distributions peripheral control center (DCC).
- h. List of events and alarms to be transmitted to the transmission's system control center and to the distribution's peripheral control center (if applicable)
- i. List of measurements received from TCC and from DCC (if required).
- j. Specifications for distance relays, over current / Earth fault relays, autotransformer/Power transformer differential relays, bus-bar differential relays, transformer REF relays, voltage relays, over flux & frequency relays shall be as per the technical specification under this bid document.

V. REQUIRED FUNCTIONS OF THE SUBSTATION AUTOMATION SYSTEM:

The substation automation system shall be capable of the following functions:

1. Control and supervision of the EHV substation
2. Switchgear interlocking.
3. Synchro-check with phasing.
4. Autotransformer tap-changer control
5. Power Transformer tap-changer control
6. Measurements
7. Event recording and alarm handling
8. Protection
9. Automatic switching
10. It must support the data points and integration of IEDs (to be calculated during detailed Engineering and also considering to cater for the present requirement of the tender as per SLD and additional 50% spare capacity for future use for all voltage levels such as 220/33kV SS).

A. Control of the EHV substation:

- i. The control must handle selection of control Position
 - a) Locally, via control switches located on the primary equipment
 - b) From the bay control unit, - bay level (located in relay kiosks)
 - c) From the HMI, - station level (Control building of the EHV Substation)
 - d) From the transmission's system remote control center (RCC)
 - e) The commands will be issued each time only from one control place excluding at the same time the other three. The priority (switching authority) of commands shall be in the order indicated above and shall be carried out either via software or hardware. Each control level shall have proper indication indicating the selected position.
- ii. Selection of equipment and type of command for control operation (opening or closing).
- iii. Execution or cancellation of command.
- iv. Execution of the command when the conditions of interlocks, Synchro-check or other conditions are met.

- v. Capability of overriding of interlocks and execution of the automatic switching sequences.
- vi. The apparatuses to be controlled are the following:
 - a) 220kV & 33kV Circuit Breakers associated with transmission line bays, transformer bays.
 - b) Dis-connectors of transmission line bays & Transformers.
 - c) Earthing switches of the 220kV Dis-connectors (If it is required.)
 - d) Mechanism of increase, decrease and emergency stop of the step of the tapchanger (OLTC) of the power transformers (if it is required).
 - e) At table 1 of the attached appendix, the necessary commands from the Substation Automation System (S.A.S) to the EHV substation equipment are presented, as well as the commands that required to be received from RCC (RemoteControl Centre) remote control centers.

B. The supervision of the substation shall include the following:

1. The position of each circuit breakers on a continuous basis.
2. The position of each dis-connectors (isolators) on a continuous basis.
3. The position of each earthing switch on a continuous basis.
4. Every detected change shall cause a change in the single-line diagram displayed on the operator's terminal (HMI unit) located in the EHV substation control building, notation in the event list and a print-out.
5. Alarms shall be issued, in the form of lists and print-out, in case the position changes are not caused by a command.
6. At the operator's terminal and specifically at the colour visual display, the single-line diagram of the EHV substation (including the future bays of the switching station with dotted-lines), details of the status of breakers and dis- connectors (isolators) and measurements shall be depicted.
7. The naming of the equipment shall be as indicated in the single-line diagram of the EHV substation which is provided.
8. The substation automation system for EHV substation shall also allow supervision of all EHV substation circuit breaker and motor driven (electrically operated) disconnectors and earthing switches from the transmission system's Remote control center (RCC).
9. The substation automation system shall allow supervision of the transformer

bay circuit breakers and Dis-connectors & transformer Tap position.

VI. COMMUNICATION PROTOCOLS AND OTHER COMMUNICATIONS:

The following protocols are acceptable for the communications within the EHV substation and also for the communication of the substation automation system (S.A.S) with the system's control centers.

1. Between bay level control units and HMI center, the acceptable communication protocol is IEC-61850.
2. Between transmission's system (network) control center and this substation automation system the only acceptable protocol is the following:
 - IEC 60870-5-104
 - It must (SCADA) support to integrate for the present scope with additional 50% spare capacity for future bays
3. Between protection relays and HMI center, the communication protocol is IEC-61850.
4. Between bay level control units and protection relays the acceptable protocol is IEC-61850.
5. Security of the system, because the IEC-61850 protocol is based on an Ethernet platform, sufficient security measures, must be provided, that is beyond passwords, in order to prevent unauthorized access.

VII. PLCC (If required & specifically asked for in the tender):

PLCC panels /end equipment of OPGW for tele-protection features are to be installed in Carrier Room near Control Room. Yard IEDs to be connected to PLCC / OPGW panels through hardware. The integration of PLCC or FOTE /end equipment in the SAS is to be carried out by the contract awardee.

VIII. SOFTWARE:

Any software needed for the configuration setting, parameterizing, documentation displaying and operation of the system or of the device which is composed of (bay control units, protection relays, bus bar differential protection relays and GPS) should be Window based with latest version of Window operating software. The same should be provided on the basis of a royalty free, non-exclusive with irrevocable license to use by OPTCL. Software for the analysis of fault data shall also be provided with the same terms as above.

IX. DETAIL SCOPE OF WORK:

The Substation Automation System is envisaged for following substation of

OPTCL.

- i. 220/33kV Substation.

Substation. Bus arrangements are In general as follows.

- i. 220kV: Two Bus systems.
- ii. 33kV: Main and Reserve bus arrangement.

The Remote operation and monitoring of control & protection system of above type of substation is to be executed by providing equipment's/relays as specified in the schedule.

The objective of the above work is as follows.

- a) The operation & monitoring of control & protection system is as per approved SLD and conforming to technical standard envisaged in CEA regulation- 2010 for Technical Standard construction of Electrical Plant & Transmission line.
- b) On line capturing & monitoring of Transformer local readings & protection.
- c) All the local control & protection at the sub-station for its remote operation from LDC/RCC shall be substituted by bay controller and SCADA.
- d) There must be provision for down loading event logger and D/R data at Local Substation automation system at any time during the day.
- e) Scope also includes one week training to the executives of each substation. The list of topics and on-site training shall be finalized during the course of execution.
- f) Factory Acceptance test has to be performed before dispatching equipment in the presence of representative of OPTCL and the test report should be approved by OPTCL.
- g) It is the bidders' responsibility for complete engineering/supply of necessary equipment in the substation as per specification, installation, testing & successfully commissioning of entire system as stated above including putting it to commercial operation.

X. GENERAL SYSTEM DESIGN:

- The systems shall be of the state-of-the art suitable for operation under electrical environment present in Extra High Voltage substations.
- The system shall incorporate the control, monitoring, metering,

communication and protection functions specified, event recording and evaluation of disturbance records.

- The Bay level unit comprising Bay Control Unit (BCU) are to be fitted in relay and protection panels installed in the control room.
- PLCC panels are to be located in PLCC room near Control Room (if required in tender).
- The station HMI & DR Work station should be located in Control Room building connecting bay level unit through optical cables /Ethernet cable for overall optimization in respect of cabling and control room building.
- Remote control and monitoring of the substation shall be from Remote Control Centre (RCC) i.e., Remote Control Centre through OPGW communication link unless specified otherwise. Required equipment for controlling the sub-station remotely from RCC as well as transmitting all necessary Sub-station data to SLDC should also be considered.
- Maintenance, modification or extension of components may not cause a shutdown of the whole substation automation system. Self-monitoring of components, modules and communication shall be incorporated to increase the availability and the reliability of the equipment and minimize maintenance.
- Adopt the latest engineering technology, and ensure long-term compatibility requirements.
- The system shall be designed such that personnel without any background knowledge in Microprocessor-based technology are able to operate the system. The operator interface shall be intuitive such that operating personnel shall be able to operate the system easily after having received some basic training.
- The Substation Automation System (SAS) shall be suitable for operation and monitoring of the complete substation including future extensions. Interoperability with third party 'IEC61850 Edition 2' compatible IEDs to be incorporated in future with offered SAS shall be ensured and necessary data/information shall be provided in this regard.
- The offered SAS shall support remote control and monitoring from Remote Control Centre (RCC) via gateway.

XI. System architecture:

The Substation Automation System (SAS) shall be based on a decentralized architecture and on a concept of bay-oriented, distributed intelligence. The Bay Control Unit (BCU), Bay Control Protection Unit (BCPU), protective relays etc. shall be connected to Ethernet Fiber Switch EFS through fiber optic /Ethernet cable

With PRP (**Parallel Redundancy Protocol**) configuration (to be selected based on system design requirement).

The main process information of the station shall be stored in distributed databases. The typical SAS architecture shall be structured in two levels, i.e. in a station and a bay level. At bay level, 'IEC61850 Edition 2' compatible BCU shall be provided for 220kV system for all bay level functions regarding control, monitoring and I/O processing and 'IEC61850 Edition 2' compatible Protective Relays shall be provided for different system as per specifications enumerated in the relevant section. The BCU / protection IEDs shall be connected to the switchgear through TB without any need for additional transducers. The 'IEC61850 Edition 2' Bay Control & Protection Unit (BCPU) shall be provided for control, monitoring, I/O processing and protection for 33kV

Each bay controller & IED shall be independent from each other and its functioning shall not be affected by any fault occurring in any of the other bay control units of the station.

Separate BCU / RTU for station auxiliaries shall be provided.

Substation LAN data exchange is to be realized using IEC 61850 standards having minimum speed of 100 mbps with a redundant managed switched Ethernet communication infrastructure having priority tagging. Each component/module of SAS including entire communication link shall be provided with built-in supervision and self-diagnostic features and any failures shall be alarmed to the operator.

Data exchange is to be realized using IEC 61850 protocols with a redundant managed switched Ethernet communication infrastructure by forming Dual FO Ring.

The communication shall be made in 1+1 mode, including the links between individual bay IEDs to switch in PRP mode, such that failure of one set of fiber/Ethernet link shall not affect the normal operation of the SAS. However it shall be alarmed in SAS.

At station level, the entire station shall be controlled and supervised from the station HMI. It shall also be possible to control and monitor the bay from the bay level equipment at all times.

The control priorities as described in the section (V: Sub section- A. Control of the EHV substation) shall prevent operation of a single switch at the same time from more than one of the various control levels, i.e. RCC, station HMI, bay level or apparatus level. The priority shall always be on the lowest enabled control level.

The GPS time synchronizing signal for the synchronization of the entire system shall be provided. GPS system should be compatible with SCADA protocol IEC 61850. A time accuracy of 1ms shall be achieved for all the devices within SAS.

The FOTE panels' status, Inter-tripping signals exchange between BCU and FOTE panel BCU should work on IEC 61850 protocols through GOOSE concept. Interface of the Distance protection IED directly to the PLCC's of the respective bays (hardwired) for status of PLCC & Inter Tripping signal exchange.

XII. Functional Requirements:

The Substation elements shall be operated from different locations such as:

- Remote control centers.
- **Station HMI.**
- Local Bay Controller.

But the operation shall be possible by only one operator at a time. Further, the operation shall depend on the conditions of other functions, such as interlocking, synchro check, etc. see description in ‘Bay level control functions’).

1. Select-before-execute:

For security reasons the command is always to be given in two stages:

Selection of the object and command for operation under all mode of operation except emergency operation. Final execution shall take place only when selection and command are actuated.

2. Command supervision:

Bay/station interlocking and blocking:

Software Interlocking is to be provided to ensure that inadvertent incorrect operation of switchgear causing damage and accidents in case of false operation does not take place.

In addition to software interlocking hardwired interlocking are to be provided for:

- i. Bus Earth switch Interlocking.
- ii. Transfer Bus Interlocking.

It shall be a simple layout, easy to test and simple to handle when upgrading the station with future bays. For software interlocking the bidder shall describe the scenario while an IED of another bay is switched off or fails.

A software interlock override function shall be provided which can be enabled to bypass the interlocking function.

3. Run Time Command cancellation:

Command execution timer (configurable) must be available for each control level connection. If the control action is not completed within a specified time, the command should get cancelled.

4. Self-supervision:

Continuous self-supervision function with self-diagnostic feature shall be included.

5. User configuration:

The monitoring, controlling and configuration of all input and output logical signals and binary inputs and relay outputs for all built-in functions and signals shall be possible both locally and remotely.

6. Functions:

The Functional requirement shall be divided into following levels: Bay Level Functions & System Level Functions

A. Bay level functions:

In a decentralized architecture the functionality shall be as close to the process as possible. In this respect, the following functions can be allocated at bay level:

- Bay control functions including data collection functionality.
 - Bay protection function.
1. Bay control functions:
 - a. Control mode selection
 - b. Select-before-execute principle
 - c. Command supervision:
 - i. Interlocking and blocking
 - ii. Double command
 - d. Synchro check, voltage selection
 - e. Run Time Command cancellation
 - f. Transformer tap changer control (for power transformer bays)
 - g. Operation counters for circuit breakers and pumps
 - h. Hydraulic pump/ Air compressor control and runtime supervision
 - i. Operating pressure supervision
 - j. Display of interlocking and blocking
 - k. Breaker position indication per phase

- l. Alarm annunciation
- m. Measurement display
- n. Local HMI (local guided, emergency mode)
- o. Interface to the station HMI.
- p. Data storage for at least 200 events
- q. Extension possibilities with additional I/O's inside the unit or via fiber-optic

Communication and process bus.

2. Transformer tap-changer control:

Raise and lower operation of OLTC taps of transformer shall be facilitated through Bay controller IED.

3. Bay protection functions:

The protection functions are independent of bay control function. The protection shall be provided by separate protection IEDs (numerical relays) and other protection devices as per section Relay & Protection. However, for 33kV system the bay control & protection function may be provided in one unit (BCPU).

IEDs, shall be connected to the communication infrastructure for data sharing and meet the real-time communication requirements for automatic functions. The data presentation and the configuration of the various IEDs shall be compatible with the overall system communication and data exchange requirements.

Event and disturbance recording function.

Each IED should contain an event recorder capable of storing at least 200 time- tagged events. The disturbance recorder function shall be as per protective relays. All disturbances can be viewed at Master Control Centre.

B. System level functions:

i. Status supervision

The position of each switchgear, e.g. circuit breaker, isolator, earthing switch, transformer tap changer etc., shall be supervised continuously. Every detected change of position shall be immediately displayed in the single-line diagram on the station HMI screen, recorded in the event list and a hard copy printout shall be produced. Alarms shall be initiated in the case of spontaneous position changes.

The switchgear positions shall be indicated by two auxiliary switches, normally closed (NC) and normally open (NO), which shall give ambivalent signals. An alarm

shall be initiated if these position indications are inconsistent or if the time required for operating mechanism to change position exceeds a predefined limit.

The SAS shall also monitor the status of sub-station auxiliaries. The status and control of auxiliaries shall be done through separate one or more IED and all alarm and analogue values shall be monitored and recorded through this IED.

ii. Measurements

Analogue inputs for voltage and current measurements shall be connected directly to the voltage transformers (VT) and the current transformers (CT) without intermediate transducers. The values of active power (W), reactive power (VAR), frequency (Hz), and the rms values for voltage (U) and current (I) shall be calculated.

The measured values shall be displayed locally on the station HMI and in the control centre. The abnormal values must be discarded. The analogue values shall be updated every 2 seconds. Threshold limit values shall be selectable for alarm indications.

iii. Event and alarm handling

Events and alarms are generated either by the switchgear, by the control IEDs, or by the station level unit. They shall be recorded in an event list in the station HMI. Alarms shall be recorded in a separate alarm list and appear on the screen. All, or a freely selectable group of events and alarms shall also be printed out on an event printer. The alarms and events shall be time-tagged with a time resolution of 1 ms.

iv. Substation HMI:

1. Operation:

On the HMI the object has to be selected first. In case of a blocking or interlocking conditions are not met, the selection shall not be possible and an appropriate alarm annunciation shall occur. If a selection is valid the position indication will show the possible direction, and the appropriate control execution button shall be pressed in order to close or open the corresponding object.

Control operation from other places (e.g. REMOTE) shall not be possible in this operating mode. The operator station HMI shall be a redundant with hot standby and shall provide basic functions for supervision and control of the substation. The operator shall give commands to the switchgear on the screen via mouse clicks or keyboard commands. The HMI shall give the operator access to alarms and events displayed on the screen. Aside from these lists on the screen, there shall be a printout of alarms or events in an event log.

An acoustic alarm shall indicate abnormalities, and all unacknowledged alarms shall be accessible from any screen selected by the operator.

The following standard pictures shall be available from the HMI:

- a. Single-line diagram showing the switchgear status and measured values.
 - b. Control dialogues with interlocking and blocking details. This control dialogue shall tell the operator whether the device operation is permitted or blocked.
 - c. Measurement dialogues
 - d. Alarm list, station / bay-oriented
 - e. Event list, station / bay-oriented
 - f. System status
2. HMI design principles

Consistent design principles shall be adopted with the HMI concerning labels, colours, dialogues and fonts. Non-valid selections shall be dimmed out.

The object status shall be indicated using different status colours for:

- a. Selected object under command
- b. Selected on the screen
- c. Not updated, obsolete values, not in use or not sampled
- d. Alarm or faulty state
- e. Warning or blocked
- f. Update blocked or manually updated
- g. Control blocked
- h. Normal state

Process status displays and command procedures

The process status of the substation in terms of actual values of currents, voltages, frequency, active and reactive powers as well as the positions of circuit breakers, isolators and transformer tap-changers shall be displayed in the station single-line diagram.

In order to ensure a high degree of security against undesired operation, a "select-before-execute" command procedure shall be provided. After the "selection" of a switch, the operator shall be able to recognize the selected device on the screen, and all other switchgear shall be blocked. As communication between control centre and device to be controlled is established, the operator shall be prompted to confirm the control action and only then final execute command shall be accepted. After the

“execution” of the command the operated switching symbol shall flash until the switch has reached its new position.

The operator shall be in a position to execute a command only, if the switch is not blocked and if no interlocking condition is going to be violated. The interlocking statements shall be checked by the interlocking scheme implemented at bay and station level.

After command execution the operator shall receive a confirmation that the new switching position has been reached or an indication that the switching procedure was unsuccessful with the indication of the reason for non-functioning.

3. System supervision & display:

The SAS system shall be comprehensively self-monitored such that faults are immediately indicated to the operator, possibly before they develop into serious situations. Such faults are recorded as a faulty status in a system supervision display. This display shall cover the status of the entire substation including all switchgear, IEDs, communication infrastructure and remote communication links, and printers at the station level, etc.

4. Event list:

The event list shall contain events that are important for the control and monitoring of the substation. The event and associated time (with 1ms resolution) of its occurrence has to be displayed for each event.

The operator shall be able to call up the chronological event list on the monitor at any time for the whole substation or sections of it.

A printout of each display shall be possible on the hard copy printer.

The events shall be registered in a chronological event list in which the type of event and its time of occurrence are specified. It shall be possible to store all events in the computer for at least one month. The information shall be obtainable also from a printed event log.

The chronological event list shall contain:

- a. Position changes of circuit breakers, isolators and earthing devices
- b. Indication of protective relay operations
- c. Fault signals from the switchgear
- d. Indication when analogue measured values exceed upper and lower limits. Suitable provision shall be made in the system to define two level of alarm on either side of the value or which shall be user defined for each measured.
- e. Loss of communication.

Filters for selection of a certain type or group of events shall be available. The filters shall be designed to enable viewing of events grouped per:

- e. Date & time.
 - f. Bay
 - g. Device
 - h. Function e.g. trips, protection operations etc.
 - i. Alarm class
5. Alarm list

Faults and errors occurring in the substation shall be listed in an alarm list and shall be immediately transmitted to the control centre. The alarm list shall substitute conventional alarm tableau, and shall constitute an evaluation of all station alarms. It shall contain unacknowledged alarms and persisting faults. The date and time of occurrence shall be indicated.

The alarm list shall consist of a summary display of the present alarm situation. Each alarm shall be reported on one line that contains:

- a. The date and time of the alarm.
- b. The name of the alarming object.
- c. A descriptive text.
- d. The acknowledgement state.

Whenever an alarm condition occurs, the alarm condition must be shown on the alarm list and must be displayed in a flashing state along with an audible alarm. After acknowledgement of the alarm, it should appear in a steady (i.e. not flashing) state and the audible alarm shall stop. The alarm should disappear only if the alarm condition has physically cleared and the operator has reset the alarm with a reset command. The state of the alarms shall be shown in the alarm list (Unacknowledged and persistent, unacknowledged and cleared, Acknowledged and persistent).

Filters for selection of a certain type or group of alarms shall be available as for events.

6. Object picture

When selecting an object such as a circuit breaker or isolator in the single-line diagram, the associated bay picture shall be presented first. In the selected object picture, all attributes like:

- a. Type of blocking.

- b. Authority.
 - c. Local / remote control.
 - d. RCC / SAS control.
 - e. Errors etc. shall be displayed.
7. Control dialogues.

The operator shall give commands to the system by means of mouse click located on the single-line diagram. It shall also be possible to use the keyboard for command activation. Data entry is performed with the keyboard. Dedicated control dialogues for controlling at least the following devices shall be available:

- a. Breaker and disconnectors
 - b. Transformer tap-changer
8. User-authority levels

It shall be possible to restrict activation of the process pictures of each object (bays, apparatus...) within a certain user authorization group. Each user shall then be given access rights to each group of objects, e.g.:

Display only.

Normal operation (e.g. open/close of switchgear)

Unrestricted operation (e.g. by-passed interlocking)

System administrator

For maintenance and engineering purposes of the station HMI, the following authorization levels shall be available:

No engineering allowed Engineering/configuration allowed Entire system management allowed

The access rights shall be defined by passwords assigned during the login procedure. Only the system administrator shall be able to add/remove users and change access rights.

9. Reports

The reports shall provide time-related follow-ups of measured and calculated values. The data displayed shall comprise:

- a. Trend reports:

- Day (mean, peak)
- Month (mean, peak)
- Semi-annual (mean, peak)
- Year (mean, peak)
- b. Historical reports of selected analogue Values:
 - Day (at 15 minutes interval)
 - Week
 - Month
 - Year

. It shall be possible to select displayed values from the database in the process display on-line. Scrolling between e.g. days shall be possible. Unsure values shall be indicated. It shall be possible to select the time period for which the specific data are kept in the memory

Following printouts shall be available from the printer and shall be printed on demand:

- o Daily voltage and frequency curves depicting time on X-axis and the appropriate parameters on the Y-axis. The time duration of the curve is 24 hours.
- o Weekly trend curves for real and derived analogue values.
- o Printouts of the maximum and minimum values and frequency of occurrence and duration of maximum and minimum values for each analogue parameter for each circuit in 24 hr period.
- o Provision shall be made for logging information about breaker status like number of operation with date and time indications.
- o Equipment operation details shift wise and during 24 hours.
- o Printout on adjustable time period as well as on demand for MW, MVAR, Current, Voltage on each feeder and transformer as well as Tap Positions, temperature and status of pumps and fans for transformers.
- o Printout on adjustable time period as well as on demand system frequency and average frequency.
- o Reports in specified formats which shall be handed over to successful bidder.
- c. Trend display (historical data)

It shall be possible to illustrate all types of process data as trends –input and output data, binary and analogue data. The trends shall be displayed in graphical form as column or curve diagrams with a maximum of 10 trends per screen. Adjustable time span and scaling ranges must be provided.

It shall be possible to change the type of value logging (direct, mean, sum, or difference) on-line in the window. It shall also be possible to change the update intervals on-line in the picture as well as the selection of threshold values for alarming purposes.

d. Automatic disturbance file transfer

All recorded data from the IEDs with integrated disturbance recorder as well as dedicated disturbance recording systems shall be automatically uploaded (event triggered or once per day) to a dedicated computer and be stored on the hard disc.

e. Disturbance analysis

The PC-based work station shall have necessary software to evaluate all the required information for proper fault analysis.

f. IED parameter setting

It shall be possible to access all protection and control IEDs for reading the parameters (settings) from the station HMI or from a dedicated monitoring computer. The setting of parameters or the activation of parameter sets shall only be allowed after entering a password.

g. Automatic sequences

The available automatic sequences in the system should be listed and described, (e.g. sequences related to the bus transfer). It must be possible to initiate pre- defined automatic sequences by the operator and also define new automatic sequences.

XIII. Gateway:

The Gateway shall use industrial grade components. The State of the Art Gateway requires usage of fast, powerful microcontroller based systems designed to function in the process environment in a functionally decentralized manner. The tasks of such systems are manifold and shall guarantee safe and secure operation of the entire system with high availability. Gateways shall support IEC 61850 Edition 2. Gateway shall be independent and fetch data directly from Bay level devices such as BCU, BCPU & Protection IEDs. Gateway shall be utilized in substation Automation application to interface between the IEDs and the Master (control & monitoring) devices viz. SCADA. It shall be used for a real time monitoring & control operation of the switchgears and devices pertaining to a particular voltage level of the station. There shall be provision of Two No's Gateway for redundancy purpose one shall be main & the other shall be standby.

The Gateway shall be multifunctional, designed in accordance with applicable International Electro-technical Commission (IEC), Institute of Electrical and Electronics Engineer (IEEE),

American National Standards Institute (ANSI), and National Equipment Manufacturers association (NEMA) standards, unless otherwise specified in this Technical specification. Gateway shall comply with various internet security standards like – BDEW Whitepapers and integrated Krypto-Chip or other relevant IEC/IEEE standard And also provided below in-built security as:-

- IPsec VPN
- IPsec in tunnel mode: initiator
- Authentication / encryption based on pre-shared key
- Internet Key Exchange protocol: IKEv1
- Authentication algorithms: HMAC-SHA1, HMAC-MD5
- Encryption algorithms: AES-128, 3DES.
- Diffie-Hellman group: Group1, Group2
- Security Logging
- Syslog Client

In all cases the provisions of the latest edition or revision of the applicable standards in effect shall apply. The following scheme / features shall be available:

- a) The system shall comprise the following in-built features namely failsafe control (i.e. in built check-before-execute feature), Control system, SOE buffer, Interfacing with third party IEDs if required (e.g. Multifunction Meters etc.), interfacing with third party computer system, direct GPS clock connectivity, through SNTP server or through the Master station (RCC/MCC) (main and standby mode) for time synchronization. Gateway
- b) Gateway shall be with high availability & reliability. Purchaser prefers to have gateway, which is easily expandable by addition of Processors & communication modules in existing rack to integrate with IEDs in future on open protocols. Extending the gateway software license to integrate future IEDs on open protocol. .
- c) Gateway shall not have any moving parts for data storage, heat dissipation etc.
- d) Gateway shall have multi-processors capability. CPU, Power Supply and Communication redundancy shall be provided in the same gateway rack/chassis.
- e) Gateway shall support hot swappable Processors, & Power Supplies, so that components can be replaced without need to switching off the gateway.
- f) The proposed Gateway shall have the capability to support simultaneous communications with two or more independent remote master (redundant) stations.
- g) Gateway shall use removable flash memory for storing program/database. The processor shall be of Intel minimum i5 or higher as per the latest available. This is to be decided during detailed Engineering.
- h) Automatic start-up and initialization following power restoration.
- i) Gateway shall be able to receive time synchronize packets from the master

station over IEC-60870-5-104 protocol or from the slave clock provided in the respective substation on SNTP Protocol.

- j) Accuracy of gateway's real time clock shall be better than ± 3.5 ppm.
- k) In case of power supply failure, auto start-up and restoration of the Gateway shall be possible without manual intervention.
- l) Remote database downloading and uploading of Gateway from master station shall be possible.
- m) It shall be possible to increase the number of communication ports in the Gateway by addition of plug-in modules, if required in future. The Gateway shall support the use of a different communication data exchange rate and scanning cycle on each port and different database for each master station.
- n) The proposed Gateway shall be KEMA Certified or by equivalent certification body.
- o) It shall be possible to generate events in HMI in case of failure of communication/power supply/processor module of Gateway.

B. Communication Interface:

The Substation Automation System shall have the capability to support independent remote master station. The Substation Automation System shall have communication ports as follows:

- a) Redundant link for data transmission to SLDC on IEC 104.

The communication interface to the SAS shall allow scanning and control of defined points within the substation automation system independently for control centre. The substation automation system shall simultaneously respond to independent scans and commands from employer's control centers. The substation automation system shall support the use of a different communication data exchange rate (bits per second), scanning cycle, and/or communication protocol to each remote control centre. Also, each control center's data scan and control commands may be different for different data points within the substation automation system's database.

The SAS shall also allow all necessary substation data transfer to SLDC. There may require typical protocol converter depending upon SLDC system. Communication media may be leased line, PLCC, Radio or any other means.

C. Remote Control Centre Communication (NETWORK CONTROL CENTER) Interface:

Communication channels between the Substation Automation System and the Remote control centre (Net Work Control Centre) will consist either of OPGW, power line carrier, microwave, optical fiber, VSAT or leased line, as the case may be, as specified.

D. Interface equipment:

The Contractor shall provide interface equipment for communicating between

Substation Automation system and Remote control centre (RCC).

In case of PLCC communication any modem supplied shall not require manual equalization and shall include self-test features such as manual mark/space keying, analogue loop-back, and digital loop-back. The modems shall provide for convenient adjustment of output level and receive sensitivity. The modem should be standalone complete in all respects including power supply to interface the SAS with communication channel. The configuration of tones and speed shall be programmable and maintained in non-volatile memory in the modem. All necessary hardware and software shall also be in the scope of bidder except the communication link along with communication equipment between substation control room and Remote Control Centre.

E. Communication Protocol:

The communication protocol for gateway to control centre must be open protocol and shall support IEC 60870-5-104 and IEC 61850 for all levels of communication for sub-station automation such as Gateway to remote station and Bay to station HMI, etc. respectively.

XIV. System hardware:

A. SCADA Equipment:

The contractor shall provide redundant station HMI in hot standby mode.

It shall be capable to perform all functions for entire substation including future requirements as indicated in the SLD. It shall use industrial grade components.

Processor and RAM shall be selected in such a manner that during normal operation not more than 30% capacity of processing and memory are used. Supplier shall demonstrate these features.

The capacity of hard disk shall be selected such that the following requirement should occupy less than 50% of disk space:

1. Storage of all analogue data (at 15 Minutes interval) and digital data including alarm, event and trend data for thirty (30) days.
2. Storage of all necessary software,
3. **500** GB space for OWNER'S use.

Supplier shall demonstrate that the capacity of hard disk is sufficient to meet the above requirement.

B. HMI (Human Machine Interface):

The VDU shall show overview diagrams (Single Line Diagrams) and complete details of the switchgear with a colour display. All event and alarm annunciation shall be selectable in the form of lists. Operation shall be by a user friendly function keyboard

and a cursor positioning device. The user interface shall be based on WINDOWS concepts with graphics & facility for panning, scrolling, zooming, decluttering etc.

C. Mass Storage Unit:

The mass storage unit shall be built-in to the Station HMI. All operational measured values and indications shall be stored in a mass-storage unit of CD-ROM / DVD-ROM with 700 MB or more capacity. The unit should support at least Read (48X), Write (24X), and Re-Write (10X) operations, with Multi-Session capability. It should support ISO9660, Rock ridge and Joliet File systems. It should support formatting and use under the operating system provided for Station HMI. The monthly back up of data shall be taken on disc. The facility of back up of data shall be inherent in the software.

D. Visual Display Units/TFT's (Thin Film Technology):

The contractor shall provide three display units, one for station HMI, one for redundant HMI and one for DR work station. These shall have high resolution and reflection protected picture screen. High stability of the picture geometry shall be ensured. The screen shall be at least 27" diagonally in size and capable of colour graphic displays. The display shall accommodate resolution of 1920 X 1080pixels. The HMI shall be able to switch the key board and cursor positioning device, as unit among all the monitors at a console with push button or other controls.

Large Video Wall-Full HD:

The large screen Video wall size Min 67" (2x2 matrixes) in the control room shall be used for the display of important graphics from the pc, workstation, Images from IP video cameras. The size of the large video display unit of Min 67" (2x2) (for 132/33,220/33 & 220/132/33 KV S/S) & Min 67" (2x2) inches (for 400/220 KV S/S) (Make: Toshiba/ SONY/ SAMSUNG) and its peripherals suitably connected to SAS shall be provided in each station as per the technical specification. The Visual Display Unit shall be Full HD LED.

E. Printers

It shall be laser jet colour printer & the printing operation shall be quiet with a noise level of less than 55 dB suitable for location in the control room. Printer shall accept and print all ASCII characters via master control computer unit interface.

The printer shall have in built testing facility. Failure of the printer shall be indicated in the Station HMI. The printer shall have an off line mode selector switch To enable safe maintenance. The maintenance should be simple with provisions for ease of change of print head, ribbon changing, paper insertion etc.

F. Switched Ethernet Communication Infrastructure:

The bidder shall provide the redundant switched optical Ethernet communication infrastructure for SAS. The bidder shall keep provision of 20% spare capacity for employer use.

One set of switches (two no's in case of PRP) shall be provided to connect all IEDs of 2 bays 220kV and all IEDs of 4 bays 33kV. Ethernet switch must be Layer-2 with IP 40. It shall be -40 to 85 °C operating temperature (no fans). Ethernet switch shall have rear RJ45 & FO port and front LED.

Bidder needs to provide dual FO Substation Ring between all Ethernet switches.

G. Bay level unit (BCU)

a) Location:

The bay control units will be located inside the relay panels, which are located throughout the EHV substations. BCUs shall be 'IEC61850 Edition 2' & PRP compliant as per IEC 62439-3.

b) Interfacing:

All bay control units shall contain an optical-fiber/ RJ45 (Selection of port by owner as per the suitability & project specific) serial interface for connection to the HMI center and RJ45 / RS232 / USB port at front for local parameterization (Selection of port by owner as per the suitability & project specific) serial interface for connection to a PC.

All optical-fiber cables/Ethernet (as per the selection by the owner) will be part of the supply as well.

c) Interfacing with the equipment of the switchyard:

The bay control units shall be capable of interfacing with the equipment of the switchyard. All digital and analog input signals from the equipment of the switchyard and out-going carrying command and control signals to the various equipment will interface with the bay control units through terminal blocks located inside the relay kiosks. These incoming and out-going signals will be wired by PPC with conventional control cables of cross section of 2.5 mm² (that is from the terminal blocks to and from the switchyard equipment) except for the VTs and CTs circuits, which utilize cables of 4mm² in cross section

d) Isolation from the switchyard equipment:

The bay control units shall provide isolation from the switchyard equipment via heavy duty relay contacts or by other means.

e) Parameterization and control:

Control for the bay control units shall be performed via an integrated graphic display and keypad and Parameterization shall be done via PC/Laptop.

f) Analog inputs signals:

Analog input signals can be input to the bay control units either via analog transducers or by direct connection to CTs and VTs. If transducers are required, the supplier will

supply these transducers.

g) Mounting:

The bay control units shall be suitable for panel flash mounting or ½ flash panel mounting.

The bay unit shall use industrial grade components. The bay level unit, based on microprocessor technology, shall use numerical techniques for the calculation and evaluation of externally input analogue signals. They shall incorporate select-before-operate control principles as safety measures for operation via the HMI. They shall perform all bay related functions, such as control commands, bay interlocking, data acquisition, data storage, event recording and shall provide inputs for status indication and outputs for commands. They shall be directly connected to the switchgear via TBs. Connections from BCU to switchgear should not be terminated directly on I/O boards but should be routed through Terminal Boards (TB). The bay unit shall acquire and process all data for the bay (Equipment status, fault indications, measured values, alarms etc.) And transmit these to the other devices in sub-station automation system. In addition, this shall receive the operation commands from station HMI and control centre. The bay unit shall have the capability to store all the data for at least 24 hours. One No. Bay level unit shall be provided for supervision and control of each 220 & 33 KV bay (a bay comprises of one circuit breaker and associated disconnectors, earth switches, instrument transformers etc.). The Bay level unit shall be equipped with analogue and binary inputs/outputs for handling the control, status monitoring and analogue measurement functions. All bay level interlocks are to be incorporated in the Bay level unit so as to permit control from the Bay level unit/ local bay mimic panel, with all bay interlocks in place, during maintenance and commissioning or in case of contingencies when the Station HMI is out of service. The Bay level unit shall meet the requirements for withstanding electromagnetic interference according to relevant parts of IEC 61850. Failure of any single component within the equipment shall neither cause unwanted operation nor lead to a complete system breakdown.

Surface-mount technology (SMT) should be used for printed circuit boards (PCB) of BCU. Further a conformal coating should be applied to the PCB for ensuring optimum performance under the toughest environment conditions.

h) Input/output (I/O) modules

The I/O modules shall form a part of the bay level unit and shall provide coupling to the substation equipment. The I/O modules shall acquire all switchgear information (i.e. data coming directly from the switchgear or from switchgear interlocking devices) and transmit commands for operation of the switchgear. The measured values of voltage and current shall be from the secondary of instrument transformers. The digital inputs shall be acquired by exception with 1ms resolution. Contact bouncing in digital inputs shall not be assumed as change of state. Connections from BCU to switchgear should not be terminated directly on I/O boards but should be routed through Terminal Boards (TB).

i) Technical Parameters of BCU

1. **Power supply:** 220 VDC, + 20%, Power consumption: < 50W
Ripple (peak to peak) : < 12%.

2. **Protocol Capabilities:** The BCU should have Ethernet module to connect to the communication buses (like the station bus) that use the IEC 61850-8-1 protocol.

The module should have two optical ports with LC connectors or two Ethernet electrical RJ 45 connectors in PRP mode based on SAS design requirement.

IEC 61850-8-1 communication protocol-100BASE-FX/TX,

Transmission rate-1000Mbit, Ethernet Electrical –RJ45, Test Volt-500V AC against ground. Distance Max. 20meter.

Ethernet Optical- LC/ST connector, Wavelength- 1300nm, Distance-Max.1.5kM.

3. **IED Communication:**

A. 'IEC61850 Edition 2' & PRP as per IEC 62439-3.

B. Time synchronization: External Time Synchronization from EthernetSNTP Time Server (<1ms accuracy)

4. **Binary Input processing:** Hardwired Digital Input should be acquired via digital boards or IED connected by a serial link. Software Digital Input coming from configurable relays & other devices with 1ms time tagging support GOOSE mode digital boards or IED connected by a serial link. Software Digital Input coming from configurable relays & other devices with 1ms time tagging. Support GOOSE mode.

No of Binary Input: No. of Digital Input shall be as per the system requirement as per the standard practice, which is as decided during the detailed Engineering and with 30% spare in each BCU.

Operating Volt: 220V DC. (Max.300V)

5. **Analogue Input processing:**

a. **Four Voltage Inputs:**

Nominal AC voltage (V_n) range: 110V, $110V/\sqrt{3}$

Frequency operating range: 50 Hz \pm 10%

VT load rating: 10 seconds with no destruction 880 V r m s

b. **Four Current Input:**

Nominal AC current (I_n): 1A r m s Minimum measurable current with same Accuracy: 0.2A r m s Maximum measurable current 4A r m s ($4*I_n$) Frequency 50 Hz \pm 10%.

c. Analogue Transducers input:

8 insulated transducer input (-20mA to +20mA) values on 8 independent galvanic-isolated channels for Transformer bays. This means that there is no common point of contact between two analogue inputs. Each analogue input can be configured in the current range or voltage range.

Overload Capacity: 100mA

Sampling period 100ms

Accuracy 0, 1% full scales for each range at 25°C

6. Measured value acquisition :

Monitoring of calculated four CT & four PT/ CVT direct primary measures.

7. Derived values: From the direct primary measures:

RMS currents & voltages, network frequency, active power, reactive power, apparent power, Power factor, Phase angles.

8. Digital Outputs: DO used for switching device in field or inside C/R via digital boards, should also configurable & contain security, interlocks etc.

No. of Digital Output shall be as per the system requirement as per the standard practice, which is as decided during the detailed Engineering and with 30% spare in each BCU.

Note: *The data regarding Digital Input, Output, and Transducers etc. for BCU/BCPU/Aux BCU as indicated above are indicative. However, the Minimum Nos. of Digital Input, Output, and Transducers etc. For BCU/BCPU/Aux BCU as indicated below are required to be considered for BCU/BCPU/Aux BCU.*

- (a) **BCU for 220kV side:** Numerical Bay control unit: 64 Nos. Digital input & 32 Nos. digital output, 8 AI (for Transformer only) with four CT input, four VT Input. IEC 61850 - ED2 protocol with PRP on FO. Power Supply 220V DC.
- (b) **BCPU for 33kV side:** Integrated Numerical Bay control unit with protection function: 32 Nos. Digital input & 24 Nos. digital output with four CT input, four VT Inputs .IEC 61850 - ED2 with PRP on FO. Power supply 220V DC.
- (c) **Aux BCU:** 64 Digital input, 10Nos digital output, 32 insulated transducer input (-20mA to +20mA) values on 32 independent galvanic-isolated channels without CT / PT Input cards. IEC 61850 Ed-2 PRP on FO protocol For station Auxiliary monitoring

Note: GIS Monitoring signal and Any Modbus protocol devices to be directly

connected to station LAN, not through any intermediate devices.

Nominal operating voltage: 220VDC (Max.300V)

Make: 5A

Carry: 5A continuously

30A for 500m seconds.

Break DC: 50 W resistive, 15 W inductive (L/R = 40 ms).

9. **Sub-station/bay:** Should use logical equation and pre-defined Inter-locking rules & sub-station topology for operation.

: Should use logical equation and pre define Inter-locking rules & sub-station topology for operation.

10. **Trip Circuit Supervision:** Supervise trip circuits for both the conditions of Breaker.

11. **Event Logging:** Storage of events up to 200 in ROM.

12. **Disturbance files & wave forms:** Minimum Five records of waveforms and disturbance record of wave forms files stored and accessible by HMI/DR work Station.

13. **Gateway support:** Should interface with Gateway for Remote Control facility

14. **Local control, Operation:** Local control & Operation should be possible and Display using backlit LCD Display and keypad of BCU.

15. **Self- monitoring:** Power ON and continuous cyclic self-monitoring tests. Abnormality result should be displayed.

16. **I/O processing:** As per our required I/O and I/O count provided above list with 20% extra for Capacities each bay.

17. **Internal Ethernet :** 1 X 10/100 Base T (RJ-45) ports or 1X10/100 Base Fx (optical) ports

18. **Additional ports:** 1 X RS232/USB /RJ45 in front for parameterization Modbus, should be s/w configurable.

19. **Environmental conditions :** Operating temperature: -5°C to +55 °C Storage temperature: -5°C to + 70 °C

: 0°C to + 70 °C Humidity: 5 to 95 % (Non-condensing).

20. **Mounting & design:** Flush or Rack Mounted Type with modular design.

21. **Warranty.** 3 year of on-site comprehensive.

XV. Inverters for SAS

2 no. of inverter SCADA Compatible with static bypass switch with no separate Battery bank. Input supply: 220VDC and 230VAC and Output: 230VAC. One Inverter will be connected for Main HMI, DR PC and Another Inverter will be connected to Redundant HMI and printer. An arrangement should be made such that it should be always connected with the inverter which provides load to SCADA equipment.

INPUT SPECIFICATION:

Voltages: 230 VAC Frequency 50 Hz & 220 V DC

Voltage Range -20% to +15%

Protection Input circuit breaker provided protection to the unit, load and personnel. Input Circuit Breaker will be higher interruption rated.

Input Current: for AC input: Sinusoidal 0.95 PF under all line/load conditions and for D.C input: as per load condition.

OUTPUT SPECIFICATION:

Available Output Ratings (KVA or KW to be specified): 3 KVA / 2.1 KW

Output Voltages: 230 VAC

Voltage Regulations: $\pm 3\%$ No Load to Full Load, High Line to Low Line

Frequency: 50 Hz ± 0.5 HZ (when on inverter)

Output Wave Form: Sine Wave

Harmonic Distortion: $< 5\%$ THD; $< 3\%$ Single Harmonic crest Factor 3 to 1

Overload: 125% for Ten (10) Minutes; 150% Surge for 10 seconds

Protection Internal electronic overload protection. Circuit breaker provides inherent overload protection.

Efficiency: 90% typical

Isolation: Complete from line. Output neutral bonded to ground

Noise Isolation: 120 dB Common-Mode: -60 dB Transverse- Mode

Power Connections Hard Wired (Terminal Block) Optional Output Receptacle Panels w/NEMA Type Receptacles and Over current Protection

XVI. Extendibility in future:

Offered substation automation system shall be suitable for extension in future for additional bays. During such requirement, all the drawings and configurations, alarm/event list etc. displayed shall be designed in such a manner that its extension shall be easily performed by the employer. During such event, normal operation of the existing substation shall be unaffected and system shall not require a shutdown. The contractor shall provide all necessary software tools along with source codes/ device configuration files to perform addition of bays in future and complete integration with SAS by the user. These software tools shall be able to configure IED, add additional analogue variable, alarm list, event list, modify interlocking logics etc. for additional bays/equipment which shall be added in future. HMI h/w & s/w should also support extreme extendibility as per future layout.

XVII. Software structure:

The software package shall be structured according to the SAS architecture and strictly divided in various levels. Necessary firewall shall be provided at suitable points in software to protect the system. An extension of the station shall be possible with lowest possible efforts. Maintenance, modification or an extension of components of any feeder may not force a shut-down of the parts of the system which are not affected by the system adaptation.

1. Station level software:

a. Human-machine interface (HMI)

The base HMI software package for the operator station shall include the main SAS functions and it shall be independent of project specific hardware version and operating system. It shall further include tools for picture editing, engineering and system configuration. The system shall be easy to use, to maintain, and to adapt according to specific user requirements.

Systems shall contain a library with standard functions and applications.

b. System software:

The system software shall be structured in various levels. This software shall be placed in a non-volatile memory. The lowest level shall assure system performance and contain basic functions, which shall not be accessible by the application and maintenance engineer for modifications. The system shall support the generation of typical control macros and a process database for user specific data storage. In case of restoration of links after failure, the software along with hardware shall be capable of automatically synchronizing with the remaining system without any manual interface. This shall be demonstrated by contractor during integrated system test.

c. Gateways Software:

i. Gateway (RCC):

Software of Gateway should be suitable for controlling s/s remotely.

Software of Gateway should be suitable for controlling s/s remotely and sending station monitoring data and station Auxiliary data.

d. Application software:

In order to ensure robust quality and reliable software functions, the main part of the application software shall consist of standard software modules built as functional block elements. The functional blocks shall be documented and thoroughly tested. They form part of a library. The application software within the control/protection devices shall be programmed in a functional block language.

e. Network Management System for D.R. Work Station:

The contractor/ Manufacturer shall provide network management system software for following management functions:

- i. Configuration Management
- ii. Fault Management
- iii. Performance Monitoring.

This system shall be used for management of communication devices and other IEDs in the system. This NMS can be loaded in DR work-station and shall be easy to use, user friendly and menu based. The NMS shall monitor all the devices in the SAS and report if there is any fault in the monitored devices. The NMS shall:

- i. Maintain performance, resource usage, and error statistics for all managed links and devices and present this information via displays, periodic reports and on demand reports.
 - ii. Maintain a graphical display of SAS connectivity and device status.
 - iii. Issue alarms when error conditions occur.
 - iv. Provide facility to add and delete addresses and links.
- f. The contractor shall provide each software in two copies in CD to load into the system in case of any problem related with Hardware/Communication etc.

XVIII. TESTS:

The bidder shall submit the complete type test reports as stated hereunder for the offered item along with the offer otherwise the offer shall be liable to be rejected. These tests must have been conducted in the NABL approved laboratory as per IEC 60255, IEC 60068, IEC 61000, IEC 60529, IEC 61010-1 & IEC 61850. Complete type test reports containing test procedure, drawings, oscillograms etc. shall be submitted.

The substation automation system offered by the bidder shall be subjected to

following tests to establish compliance with IEC 61850 for EHV substation equipment installed in sheltered area in the outdoor switchyard and specified ambient conditions:

A. Type Tests:

1. Control IEDs and Communication Equipment:

a. Performance tests:

- i. Accuracy requirements
- ii. Limits of operating range of auxiliary energizing inputs and auxiliary Voltage dependence.
- iii. Limits of frequency range and frequency dependence
- iv. Rated burden
- v. Mechanical Endurance test
- vi. Characteristic and Functional test

b. Thermal requirements:

- i. Maximum allowable temperature
- ii. Limits of short time thermal withstand value of input energizing quantities
- iii. Limiting dynamic value

c. Insulation Tests:

- i. Dielectric Tests
- ii. Impulse Voltage withstand Test
- iii. Insulation resistance measurement

d. Influencing Quantities:

- i. Permissible ripples
- ii. Interruption of input voltage

e. Electromagnetic Compatibility Test:

- i. 1 MHZ burst disturbance test
- ii. Electrostatic Discharge Test

- iii. Radiated Electromagnetic Field Disturbance Test
- iv. Electrical Fast transient Disturbance Test
- v. Conducted Disturbances Tests induced by Radio Frequency Field
- vi. Magnetic Field Test
- vii. Emission (Conducted and Radiated) Test.
- viii. Surge Immunity Test
- f. Contact performance Test
 - i. Contact making/Breaking capacity test
 - ii. Continuous capacity
- g. Environmental tests:
 - i. Cold Temperature
 - ii. Dry Heat
 - iii. Storage temperature test
 - iv. Humidity (Damp heat Cycle)
- h. Mechanical Tests:
 - i. Vibration response & Vibration endurance test
 - ii. Bump test
 - iii. Shock response test
 - iv. Seismic test
- i. Enclosure Test:
 - i. Degree of Protection test – IP51
- j. Safety Test:
 - i. Single fault condition assessment
 - ii. Earth bonding impedance test
 - iii. Mechanical resistance to shock and impact

iv. Protection against electrical shock

v. Protection against the spread of fire

k. IEC 61850 Compatibility tests

B. Factory Acceptance Tests:

The supplier shall submit a test specification for factory acceptance test (FAT) and commissioning tests of the station automation system for approval. For the individual bay level IED's applicable type test certificates shall be submitted. The manufacturing phase of the SAS shall be concluded by the factory acceptance test (FAT). The purpose is to ensure that the Contractor has interpreted the specified requirements correctly and that the FAT includes checking to the degree required by the user. The general philosophy shall be to deliver a system to site only after it has been thoroughly tested and its specified performance has been verified, as far as site conditions can be simulated in a test lab. If the FAT comprises only a certain portion of the system for practical reason, it has to be assured that this test configuration contains at least one unit of each and every type of equipment incorporated in the delivered system. If the complete system consists of parts from various suppliers or some parts are already installed on site, the FAT shall be limited to sub-system tests. In such a case, the complete system test shall be performed on site together with the site acceptance test (SAT).

C. Integrated Testing:

The integrated system tests shall be performed as detailed in subsequent clauses as per following configuration:

Redundant Station HMI, DR work station, two switches (i.e. for two diameters) along with all IEDs for the Dia. and printers.

All other switches for complete sub-station as detailed in section project shall be simulated as needed.

D. Hardware Integration Tests:

The hardware integration test shall be performed on the specified systems to be used for Factory tests when the hardware has been installed in the factory. The operation of each item shall be verified as an integral part of system. Applicable hardware diagnostics shall be used to verify that each hardware component is completely operational and assembled into a configuration capable of supporting software integration and factory testing of the system. The equipment expansion capability shall also be verified during the hardware integration tests.

E. Integrated System Tests:

Integrated system tests shall verify the stability of the hardware and the software. During the tests all functions shall run concurrently and all equipment shall operate a continuous 100 Hours period. The integrated system test shall ensure the SAS is free

of improper interactions between software and hardware while the system is operating as a whole.

F. Field Tests:

The field tests shall completely verify all the features of SAS hardware and software.

G. System Performance:

It shall be the responsibility of the bidder to predict and indicate in the bid, the worst case loading condition and design the system accordingly to meet the same. The worst case loading condition shall include following

- All analogue inputs scanning and processing in progress and all data is being transmitted over the system bus every one second.
- A burst of 100 alarms is generated over a period of 10 seconds.
- An operator control is generated every 10 seconds.
- Data collection for logs/reports is in progress.
- Data collection for historical storage and trend function in progress.
- Data collection of fault record is in progress.
- All health monitoring functions/diagnostics in progress.
- All output devices are in operation with rated performance/speed.
- All data are transferred to the control centre.

The updating time on the operator station under normal and calm/worst conditions in the station shall be:

Function: Response Time

From Selection of object to picture colour change form object: < 1 Sec.

Command Execute: < 1 Sec.

Display of binary change:< 0.5 Sec.

Display of Analog Value Change: <1 Sec.

System Display with 100 variables: Max.3 Sec.

Times taken to report the last of 50 simultaneous alarms Max. 5 Sec. Updating Database < 1 Sec.

H. Duty cycle time:

- a. Under worst loading condition processor shall have
 - 1. 40 % free time when measured over any two second period
 - 2. 60% free time when measured over any one minute period
- b. Substation network spare time

50 % spare time when measured over any two second period during worst case loading conditions.

Bidder shall furnish necessary data to fully satisfy employer that processor spare duty cycle figures quoted by the bidder are realistic and based on configuration and computational capability of the offered system and these shall be actually implemented system as commissioned at project site.

XIX. System Operation

1. Substation Operation

a. Normal Operation

Operation of the system by the operator from the MCC or at the substation shall take place via industry standard HMI (Human Machine interface) subsystem consisting of graphic colour VDU, a standard keyboard and a cursor positioning device (mouse).

The coloured screen shall be divided into 3 fields:

- i) Message field with display of present time and date
- ii) Display field for single line diagrams
- iii) Navigation bar with alarm/condition indication

For display of alarm annunciation, lists of events etc., a separate HMI View node shall be provided.

All operations shall be performed with mouse and/or a minimum number of function keys and cursor keys. The function keys shall have different meanings depending on the operation. The operator shall see the relevant meanings as function tests displayed in the command field (i.e. operator prompting). For control actions, the switchgear (i.e. circuit breaker etc.) requested shall be selectable on the display by means of the cursor keys.

The switching element selected shall then appear on the background that shall be flashing in a different color. The operator prompting shall distinguish between:

Prompting of indications e.g. fault indications in the switchgear, and prompting of operational sequences e.g. execution of switching operations.

The summary information displayed in the message field shall give a rapid display of alarm/message of the system in which a fault has occurred and alarm annunciation lists in which the fault is described more fully.

Each operational sequence shall be divided into single operation steps which are initiated by means of the function keys/WINDOW command by mouse. Operator prompting shall be designed in such a manner that only the permissible keys are available in the command field related to the specific operation step. Only those switching elements shall be accessed for which control actions are possible. If the operation step is rejected by the system, the operator prompting shall be supported by additional comments in the message field. The operation status shall be reset to the corresponding preceding step in the operation sequence by pressing one of the function keys. All operations shall be verified. Incorrect operations shall be indicated by comments in the message field and must not be executed.

The offer shall include a comprehensive description of the system. The above operation shall also be possible via WINDOWS based system by mouse.

XX. Power Supply:

Power for the substation automation system shall be derived UPS. Inverter of suitable capacity shall be provided for station HMIs, DR work station, Gateways and its peripheral devices e.g. printers etc. There must be redundant Inverter to feed power in case of one inverter fails. In case of failure of one Inverter supply should automatically switched over to second one. In the event of total Power failure, necessary safeguard software shall be built for proper shutdown and restart.

XXI. Documentation:

The following documents shall be submitted for employer's approval during detailed engineering:

- [a] System Architecture Drawing
- [b] Hardware Specification
- [c] Sizing Calculations of various components
- [d] Response Time Calculation
- [e] Functional Design Document

The following documentation to be provided for the system in the course of the project shall be consistent, CAD supported.

- List of Drawings.

- Substation automation system architecture.
- Block Diagram.
- Guaranteed technical parameters, Functional Design Specification and guaranteed availability and reliability.
- Calculation for power supply dimensioning.
- I/O Signal lists.
- Schematic diagrams.
- List of Apparatus.
- List of Labels.
- Logic Diagram (hardware & software).
- Control Room Lay-out.
- Test Specification for Factory Acceptance Test (FAT).
- Product Manuals.
- Assembly Drawing.
- Operator's Manual.
- Complete documentation of implemented protocols between various elements.
- Listing of software and loadable in CD ROM.

Other documents as may be required during detailed engineering.

Two sets of hard copy and four sets of CD ROM containing all the as built documents/drawings shall be provided.

XXII. GUARANTEE:

The availability for the complete SAS shall be guaranteed by the Manufacturer. Bidder shall include in their offer the detailed calculation for the availability. The contractor shall demonstrate their availability guaranteed by conducting the availability test on the total sub-station automation system as a whole after commissioning of total Sub-station Automation system. The test shall verify the reliability and integrity of all sub-systems. Under these conditions the test shall

establish an overall availability of 99.98%. After the lapse of 1000 Hours of cumulative test time, test records shall be examined to determine the conformance with availability criterion. In case of any outage during the availability test, the contractor/ Manufacturer shall rectify the problem and after rectification, the 1000 Hours period start after such rectification. If test object has not been met the test shall continue until the specified availability is achieved.

The contractor/Manufacturer has to establish the availability in a maximum period of three months from the date of commencement of the availability test.

After the satisfactory conclusion of test both contractor and employer shall mutually agree to the test results and if these results satisfy the availability criterion, the test is considered to be completed successfully. After that the system shall be taken over by the employer and then the guarantee period shall start.

The SAS supplied under this specification shall be designed and constructed to meet all specification requirements for 15 years. Further the bidder/Manufacturer should support for hardware and software for 15 (fifteen) years to guard against obsolescence. SAS equipment or components that cannot meet this life expectancy or specified design and operational requirement or likely to become obsolete during entire service life shall be identified and their expected failure rate/obsolescence period with corrective action shall be indicated by the bidder in his proposal. Otherwise SAS shall be deemed to be suitable for above requirements. All requirements/devices not listed under recommended spares shall have a normal expectancy exceeding the specified expected life of SAS.

XXIII. TRAINING, SUPPORT SERVICES, MAINTENANCE AND SPARES:

A. TRAINING:

The contractor/ Manufacturer shall impart training for 1 week for the engineers of OPTCL and cover following topics of SAS as listed below.

1. SAS Computer System Hardware Course:

A SAS computer system hardware course shall be offered, but at the system level only. The training course shall be designed to give Employer hardware personnel sufficient knowledge of the overall design and operation of the system so that they can correct obvious problems, configure the hardware, perform preventive Maintenance, run diagnostic programs, and communicates with contract maintenance personnel. The following subjects shall be covered:

- a. System Hardware Overview: Configuration of the system hardware.
- b. Equipment Maintenance: Basic theory of operation, maintenance techniques and diagnostic procedures for each element of the computer system, e.g., processors, auxiliary memories, LANs, routers and printers. Configuration of all the hardware

equipment.

- c. System Expansion: Techniques and procedures to expand and add equipment such as loggers, monitors, and communication channels.
- d. System Maintenance: Theory of operation and maintenance of the redundant hardware configuration, failover hardware, configuration control panels, and failover switches. Maintenance of protective devices and power supplies.
- e. Subsystem Maintenance: Theory of design and operation, maintenance techniques and practices, diagnostic procedures, and (where applicable) expansion techniques and procedures. Classes shall include hands-on training for the specific subsystems that are part of Employer's equipment or part of similarly designed and configured subsystems. All interfaces to the computing equipment shall be taught in detail.
- f. Operational Training: Practical training on preventive and corrective maintenance of all equipment, including use of special tools and instruments. This training shall be provided on Employer equipment, or on similarly configured systems.

2. SAS Computer System Software Course:

The Contractor/ Manufacturer shall provide a computer system software course that covers the following subjects:

- a. System Programming: Including all applicable programming languages and all stand-alone service and utility packages provided with the system. An introduction to software architecture, Effect of tuning parameters (OS software, Network software, database software etc.) on the performance of the system.
- b. Operating System: Including the user aspects of the operating system, such as program loading and integrating procedures; scheduling, management, service, and utility functions; and system expansion techniques and procedures.
- c. System Initialization and Failover: Including design, theory of operation, and practice
- d. Diagnostics: Including the execution of diagnostic procedures and the interpretation of diagnostic outputs,
- e. Software Documentation: Orientation in the organization and use of system software documentation.
- f. Hands-on Training: with allocated computer time for trainee performance of unstructured exercises and with the course instructor available for assistance as necessary.

3. SAS Application Software Course:

The Contractor shall provide a comprehensive application software courses covering

all applications including the database and display building course. The training shall include:

- a. Overview: Block diagrams of the application software and data flows. Programming standards and program interface conventions.
- b. Application Functions: Functional capabilities, design, and major algorithms. Associated maintenance and expansion techniques.
- c. Software Development: Techniques and conventions to be used for the preparation and integration of new software functions.
- d. Software Generation: Generation of application software from source code and associated software configuration control procedures.
- e. Software Documentation: Orientation in the organization and use of functional and detailed design documentation and of programmer and user manuals.
- f. Hands-on Training: with allocated computer time for trainee performance of unstructured exercises and with the course instructor available for assistance as necessary.

B. MAINTENANCE:

Maintenance Responsibility during the Guaranteed Availability Period. During guaranteed Availability Period, the Contractor shall take continual actions to ensure the guaranteed availability and shall make available all the necessary resources such as specialist personnel, spare parts, tools, test devices etc. for replacement or repair of all defective parts and shall have prime responsibility for keeping the system operational.

C. Reliability and availability:

The SAS shall be designed so that the failure of any single component, processor, or device shall not render the system unavailable. Each component and equipment offered by the bidder shall be of established reliability. The minimum target reliability of each piece or equipment like each electronic module/card Power supply, Peripherals etc. shall be established by bidder considering its failure rates/mean time between failures (MTBF), meantime to repair (MTTR), such that the availability of complete system is assured. The guaranteed annual system availability shall not be less than 99.9%. This shall be supported by detailed calculation according to availability calculations specified in IEEE standard –1046 or equivalent. This shall be submitted by bidder along with offer. The SAS shall be designed to satisfy the very high demands for reliability and availability concerning:

- i. Mechanical and electrical design
- ii. Security against electrical interference (EMI)
- iii. High quality components and boards

- iv. Modular, well-tested hardware
- v. Thoroughly developed and tested modular software
- vi. Easy-to-understand programming language for application programming
- vii. Detailed graphical documentation and application software
- viii. Built-in supervision and diagnostic functions
- ix. Security
- x. Experience of security requirements
- xi. Process know-how
- xii. Select before execute at operation
- xiii. Process status representation as double indications
- xiv. Distributed solution
- xv. Independent units connected to the local area network
- xvi. Back-up functions
- xvii. Panel design appropriate to the harsh electrical environment and ambient
- xviii. conditions
- xix. Panel grounding immune against transient ground potential rise

Outage terms:

i. Outage: The state in which substation automation system or a unit of SAS is unavailable for Normal Operation due to an event directly related to the SAS or unit of SAS. In the event, the owner has taken any equipment/ systems other than Substation Automation System for schedule/forced maintenance, the consequent outage to SAS shall not be considered as outage for the purpose of availability.

ii. Actual outage duration (AOD):

The time elapsed in hours between the start and the end of an outage. The time shall be counted to the nearest 1/4th of an hour. Time less than 1/4th of an hour shall be counted as having duration of 1/4th of an hour.

iii. Period Hours (PH):

The number of hours in the reporting period. In a full year the period hour are 8760h

(8784h for a leap year).

iv. Actual Outage hours (AOH):

The sum of actual outage duration within the reporting period $AOH = S \text{ AOD}$

v. Availability:

Each SAS shall have a total availability of 99.98 % i.e. the ratio of total time duration minus the actual outage duration to total time duration.

D. SPARES:

The contractor shall make a list of spares which may be required for ensuring the guaranteed availability of the system. The contractor should keep the same at site for free replacement during the guaranteed period. Further, the contractor shall make a list of spares for running the system with guaranteed availability beyond the guaranteed period. The said spares list shall form the part of scope of supply and accordingly the price thereof shall be quoted by the bidder and shall be considered.

All consumables such as paper, cartridges shall be supplied by the contractor till the SAS is taken over by the owner.

XXIV. ADDITIONAL REQUIRED DESIGN CHARACTERISTICS OF THE SUBSTATION AUTOMATION SYSTEM FOR THE EHV SUBSTATION:

1. All wording appearing on the VDU with regard the single line diagrams of the EHV substation shall be in English language.
2. Care shall be taken so that the system can be expanded in the future, if needed.
3. The database, after it has been created, will be delivered on CD-ROMs.
4. Due to IEC-61850 communication protocol implementation, the following should be applied:

For all “functions” within the substation, an object oriented data model will be provided grouping the data into the smallest possible independent functions named Logical Nodes (LN). Entire functionality of S.A.S split into LNs.

The LNs and all data attributes contained therein will be named according to standardized “semantic”. The Substation Configuration Language used to configure the S.A.S and individual IEDs is the SCL language.

Complete S.A.S will be formally documented within SCL especially through SCD

(Substation Configuration Description) files.

The SCD files will ensure that all system engineering work has been recorded for re-use in future adaptations, extensions and refurbishment of the S.A.S. The SCD files are part of the documentation that PPC will receive with the delivery of the System.

ANNEXURE-I:

DATA ON EXPERIENCE:

- [a] Name of the manufacturer.
- [b] Standing of the firm as manufacturer of equipment quoted.
- [c] Description of equipment similar to that quoted [supplied and installed during the last two years with the name of the organizations to whom supply was made].
- [d] Details as to where installed etc.
- [e] Testing facilities at manufacturer's works.
- [f] If the manufacturer is having collaboration with another firm, details regarding the same and present status.
- [g] A list of purchase orders, executed during last three years.
- [h] A list of similar equipment of specified MVA rating, voltage class, Impulse level, short circuit rating, Designed, manufactured, tested and commissioned which are in successful operation for at least two years from the date of commissioning with legible user's certificate. User's full complete postal address/fax/phone must be indicated.

Place:

Date:

Signature of tenderer
Name, Designation, Seal

ANNEXURE-II

SCHEDULE OF INSTALLATIONS.

Rated MVA	Rated Voltage	Place of installation and complete postal address	Year of commissioning

Place: -

Date

Signature of Tenderer:

Name, Designation, Seal

PROTECTION PANELS

Panels:

General:

Simplex panels shall be provided to suite the substations site. Panels shall be free standing mounted on floors fitted with embedded channels, insert plates or foundation bolts. The panels shall be made vibration and shock proof by providing anti vibration strips. The base frame of all panels shall have a smooth bearing surface such that when fixed on the embedded foundation channels/insert plates it shall be free standing and provide a level surface. The panels shall be completely metal enclosed, dust, moisture and vermin proof. The enclosure shall provide a degree of protection not less than IP-54 in accordance with IS 13947. The design, materials selection and workmanship shall be such that it provides a neat appearance both inside and outside without signs of welds, rivets or bolt heads from outside. The exterior surfaces shall be smooth and sleek. The panels of modern modular construction in 19 inch hinged racks would also be acceptable. Cable entry to the panels shall be from the bottom. The provision of all cable glands and shrouds of the panel shall be part of the scope of supply. Cable gland plate fitted on the bottom of the panel shall be connected to earthing of the panel/station through a flexible braided copper conductor.

Bidder shall be fully responsible for his bids to match the dimensions, colour and fittings with those in the existing control rooms where the extensions are required. In no case any proposal for increase in price at a later date shall be entertained by the

Employer. However, panels not matching those already installed may be acceptable & only after Specific approvals will be required on a case by case basis

Simplex Panel:

Simplex panels shall be provided with equipment mounted on front panel vertically. The wiring access shall be from rear for control panels and either from front or rear for relay panels. Where panel width is more than 800 mm, double leafed doors shall be provided. Doors shall be fitted with either built-in locking facility or with padlock.

Constructional Features:

It is the responsibility of the Contractor to ensure that the equipment specified and such unspecified complementary equipment required for completeness of the protective/control schemes can be properly accommodated in the panels without congestion. Panels shall be free standing, floor mounting type and shall comprise of structural frames completely enclosed with smooth finished, cold rolled sheet steel of thickness not less than 3 mm for all weight bearing members such as base frame, front panel, door frames. All other parts may be provided with 2.0 mm thick steel sheet. There shall be sufficient reinforcement to provide level surfaces, resistance to vibration and rigidity during transportation and installation. All doors, removable covers and panels shall be gasketed all around with neoprene or superior material. Ventilating louvers, where provided shall have screens and filters. The screens shall be made of either brass or GI wire mesh.

Mounting:

All equipment on and in panels shall be mounted and completely wired to the terminal blocks ready for external connections. The equipment on front of panel shall be mounted flush. Equipment shall be mounted such that removal and replacement can be accomplished individually without interruption of service to adjacent devices. Equipment shall be readily accessible without use of special tools. Terminal marking on the equipment shall be clearly visible. The Contractor shall Carry out cut-out, mounting and wiring of all equipment and items which are to be mounted in his panel. Cut-outs if any, provided for future mounting of equipment shall be properly blanked off with blanking plates. The center lines of switches, push buttons and indicating lamps shall be not less than 750 mm from the bottom of the panel. The center lines of relays, meters and recorders shall be not less than 450 mm from the bottom of the panel. The center lines of switches, push buttons and indicating lamps shall be matched to give a neat and uniform appearance. The top lines of all meters, relays and recorders etc. shall be matched. No equipment shall be mounted on the doors. All the equipment connections and cabling shall be designed and arranged to minimise the risk of fire and damage which may be caused by fire.

Terminal Blocks:

Terminal blocks and boards shall conform to the requirements of the relevant sections of this Specification. De-link type terminal blocks shall be provided in all the circuits and Terminals.

Supporting steel:

All necessary embedded levelling steel, sills, anchor bolts, channels and other parts for supporting and fastenings the panels and vibration damping shall be supplied by the Contractor.

Panel internal wiring:

Panels shall be supplied complete with interconnecting wiring provided between all electrical devices mounted and wired in the panels and between the devices and terminal blocks for the devices to be connected to equipment outside the panels. When panels are arranged to be located adjacent to each other all inter panel wiring and connections between the panels shall be furnished and the wiring shall be carried out internally. All wiring shall be carried out with 1100V grade, single core, stranded copper conductor wires with PVC (with FRLS) insulation. The minimum size of the multi-stranded copper conductor used for internal wiring shall be as follows.

- a) All CT/ CVT/VT circuits shall be using 4.0 sq. mm lead.
- b) All other circuits shall be using 2.5 sq. mm lead

All internal wiring shall be securely supported, neatly arranged, readily accessible and connected to equipment terminals and terminal blocks. Wiring gutters & troughs shall be used for this purpose. Auxiliary bus wiring for AC and DC supplies, voltage transformer circuits, annunciation circuits and other common services shall be provided near the top of the panels running throughout the entire length of the panels. Wire germination shall be made with solder less crimping type and tinned copper lugs, which firmly grip the conductor. Insulated sleeves shall be provided at all the wire terminations. Engraved core identification plastic ferrules marked to correspond with panel wiring diagram shall be fitted at both ends of each wire. Ferrules shall fit tightly on the wire and shall not fall off when the wire is disconnected from terminal blocks. All wires directly connected to trip circuit breaker or device shall be distinguished by the addition of red coloured unlettered ferrule. Longitudinal troughs extending throughout the full length of the panel shall be preferred for inter panel wiring. Inter-connections to adjacent panel shall be brought out to a separate set of terminal blocks located near the slots of holes meant for taking the inter-connecting wires. Contractor shall be solely responsible for the completeness and correctness of the internal wiring and for the proper functioning of the connected equipment.

All wiring shall be switch board type single flexible conductor tinned annealed copper wire insulated with varnished cambric, faulted asbestos, single braided cotton cover painted overall with flame proof moisture resistant paint and suitable for 660 volt service or equivalent poly vinyl chloride insulation which has proved its utility in tropical regions against hot and moist climate and vermin (Misc. white ants and cockroaches etc..) Rubber insulated wiring will not be accepted. The sizes of wiring in different circuits shall not be less than those specified below

The following colour scheme shall be used for the wiring.

Circuit where use. Colour of wire and ferrule:

Red phase of instrument transformer circuit:	Red.
Yellow phase of instrument transformer:	Yellow.
Blue phase of instrument transformer circuits:	Blue.

Neutral connections earthed or not earthed in the instrument transformer circuit:

Green.

A.C. Control wiring circuits using D.C. supply: Grey

Wiring connected to the space heaters in the cubicles shall have porcelain braided insulation over a safe length from the heater terminals.

Each wire shall be continuous from end to end without having any joint within itself. Individual wires shall be connected only at the connection terminals or studs of the terminal blocks, meters, relays, instruments and other switchboard devices.

Terminal ends of all wires shall be provided with numbered ferrules suitable coloured for phase identification. At point of inter/connection where a change of number is necessary, duplicate ferrules shall be provided with the appropriate numbers on the changing end.

At the terminal connection, washers shall be interposed between terminals, wire terminals and the holding nuts. All holding nuts shall be secured by locking nuts. The connection stud shall project at least 6 mm. from the lock nut surface.

Wire ends shall be so connected at the terminal studs that no wire terminal number ferruled gets masked due to succeeding connections. All wires shall be suitable for bending to meet the terminal stud at rectangles with the stud axis, and they shall not be skewed.

All studs, nuts, bolts, scores, etc. shall be threaded according to the British Standard practice unless Employer's prior approval to any other practice of threading is obtained. Spare quantities of nuts, lock nuts and washers of all varieties used on the panel board shall be supplied to the extent of 10% of the used quantities.

TERMINAL BLOCKS:

All the terminal blocks to be used in the panel shall be provided with 1100V grade stud type terminal block of Polyamide material of [Phoenix/Elmex / Connect well](#). At least 20% spare terminals shall be provided.

- (i) All internal wiring to be connected to external equipment shall terminate on terminal blocks. Disconnecting type Terminal blocks shall be 1100 V grade and have 20 Amps. Continuous rating, moulded piece, complete with insulated barriers, stud type terminals, washers, nuts and lock nuts, Markings on the terminal blocks shall correspond to wire number and terminal numbers on the wiring diagrams. All terminal blocks shall have shrouding with transparent unbreakable material. Terminal Block connectors built from cells of moulded dielectric and brass stud inserts shall be provided for terminating the outgoing ends of the cubicle wiring and the corresponding incoming tail ends of the control cables. All the terminal connectors shall have de-linked (disconnecting) facilities.
- (ii) Disconnecting type terminal blocks for current transformer and voltage transformer secondary leads shall be provided. Also current transformer secondary leads shall be provided with short-circuiting and earthing facilities.
- (iii) At least 20% spare terminals shall be provided on each panel and these spare terminals shall be uniformly distributed on all terminal blocks.
- (iv) Unless otherwise specified, terminal blocks shall be suitable for connecting the

following conductors of external cable on each side.

- (v) There shall be a minimum clearance of 250mm between the first row of terminal blocks and the associated cable gland plate or panel sidewall. Also the clearance between two rows of terminal blocks edges shall be minimum of 150mm
- (vi) Arrangement of the terminal block assemblies and the wiring channel within the enclosure shall be such that a row of terminal blocks is run in parallels and close proximity along each side of the wiring duct to provide for convenient attachment of internal panel wiring. The side of the terminal block opposite the wiring duct shall be reserved for the owner's external cable connections. All adjacent terminal blocks shall also share this field-wiring corridor. All wiring shall be provided with adequate support inside the panels to hold them firmly and to enable free and flexible termination without causing strain on terminals.
- (vii) The number and sizes of the Owner's multi core incoming external cables will be furnished to the contractor after placement of the order. All necessary cable-terminating accessories such as gland plates, supporting clamps & brackets, wiring troughs and gutters etc. (except glands & lugs) for external cables shall be provided.

SPACE FOR CONTROL CABLES AND CABLE GLANDS:

Sufficient space for receiving the control cables inside the board at the bottom of the cubicles and mounting arrangement for the terminal cable glands shall be provided. The specification does not cover supply of control cables and cable glands for which the employer will make separate arrangement.

SPACE HEATERS:

60 W. 240 V. 50 HZ tubular space heaters with thermostat auto suitable for connection to the single phase AC supply complete with on-off switches located at convenient positions shall be provided at the bottom of the switch board cubicle to prevent condensation of moisture. The watt loss per unit surface of heater shall be low enough to keep surface temperature well below sensible heat.

2.0 DISTRIBUTION AND CONTROL OF AUXILIARY POWER CIRCUIT:

2.1 D.C. CIRCUIT:

There shall be separate D.C. supply source from the main DCDB to be connected to each panel. The incoming DC supply sources (source I and source II) circuits in the panel shall be controlled by the two pole DC MCB's as incoming to the panels and the sub circuits shall be controlled by HRC fuses of different circuits having both "+" ve and "-" ve control. A continuous D.C. bus shall be provided in the panel for control, protection, supervision and indication circuit and other equipment shall be teed off in each panel from D.C. bus through a set of HRC Fuse (both on +ve and -

ve side) D.C. supply to individual panel thus teed off shall be distributed within the panel as below.

2.2 SWITCHES:

Each panel shall be provided with necessary arrangement for receiving, distributing and isolating of DC and AC supplies for various control, signalling, lighting and space heater circuits. The incoming and sub-circuits shall be separately provided with required rating DC & AC MCB's. The selection of the main and sub circuit MCB rating shall be such as to ensure selective clearance of sub- circuit faults. Voltage transformer circuits for relaying and metering shall be protected by MCB. All MCB shall be confirming to relevant IEC/IS standard. The short time MCB rating of shall be more than 10kA. The MCB shall have imprints of the fuse rating and voltage.

DC supply source1 & 2 supervision SCADA compatibility relays are to be mounted in the panel.

Provision of DC illumination lamp with switch to be provided in each panel.

A.C. CIRCUIT:

240 volts, single phase, A.C. auxiliary supply to the control and relay board will be fed from A.C. distribution board through a suitable fuse switch provided thereof. A continuous A.C. bus shall be provided the panel where from A.C. supply to each panel shall be teed off through a set of links. One 16 Amp rated M.C.B. shall be provided for the incoming A.C. supply. A set of fuse and link rated for 6 amps for 3 pin plug circuit, 6 amps for 2 pin ply circuit and 6 amps for heater and illuminating lamp circuits shall also be provided.

AC supply supervision SCADA compatibility relays are to be mounted in the panel.

TEST BLOCKS:

Switchboard type, back connected, test blocks with contacts shall be provided with links or other devices for shorting terminals of C.T. leads before interrupting testing instruments in the circuit without causing open circuit of the C.T. The potential testing studs shall preferably be housed in narrow recesses of the, block moulding insulation to prevent accidental short-circuit across the studs. All Test Blocks for meters, relays, etc. shall be placed as close to the respective equipment as possible.

SAFETY EARTHING FOR THE PANEL:

All panels shall be equipped with an earth bus securely fixed. Location of earth bus shall ensure no radiation interference for earth system under various switching conditions of isolators and breakers. The materials and size of the bus shall be at least 25X6 sq.mm perforated copper threaded holes at gap of 50mm with a provision of bolts and nuts for connection with cable armours and mounted equipment etc., for effective earthing. When several panels are mounted adjoining each other, the earth bus shall be made continuous and necessary connectors and clamps for this purpose shall be included in the scope of supply. Provision shall be made for extending the

earth bus bars to future adjoining panels on either side.

Provision shall be made on each bus bar of the end panels for connecting substation earth grid. Necessary clamps and connectors shall be included in the scope of contract.

All metallic case of the relays, instruments and other panel mounted equipment including gland plate shall be connected to the earth bus by copper wires of size not less than 2.5 sq.mm. The colour code of earthing shall be green.

Looping of earth connections, which would result in loss of earth connections to other devices when loop is broken, shall not be permitted. However looping of earth connections between equipment to provide alternative path to earth bus shall be provided.

VT and CT secondary neutral or common lead shall be earthed at one place only at the terminal blocks where they enter the panel. Such earthing shall be made through links so that earthing may be removed from one group without disturbing the continuity of earthing system for other groups.

PANEL BOARD LIGHTING:

The panel interior shall be illuminated by 20W, CFL tube light connected to 240 V. single phase A.C. The illumination of the interior shall be free from hand shadows and shall be planned to avoid any strain or fatigue to the fireman likely to be caused due to subnormal or non-uniform illumination. One emergency D.C. light (CFL type) shall also be provided for each relay panel with individual switch, with proper identification mark.

A door operated button switch shall be provided for control of the A.C. lighting for all the control and relay panel interiors.

One 5 amps. Two pin socket and one 15 amps. 3 pin power socket outlets together with plugs shall be provided at convenient points in the panel board for A.C. supply.

3.0 Relays:

General:

The Numerical Relays in general shall comply with the following requirements:

1. All relays shall conform to the requirements of IS: 3231/IEC60255/IEC 61000 or other applicable standards. Relays shall be suitable for flush or semi flush mounting on the front with connections from the rear.
2. The offered relays shall be completely numerical.
 - The communication protocol shall be as per 'IEC61850 Edition 2'
 - The test levels of EMI as indicated in IEC 61850 shall be applicable to these relays.
 - Protection elements should be realized using software algorithm.
 - Hardware based measurement shall not be acceptable.
3. The relay shall be provided with both 1A and 5A CT inputs and shall be selectable at site.
4. It shall be possible to energize the relay from either AC or DC auxiliary supply.

5. The offered relay shall have a comprehensive local HMI for interface. It shall have the following minimum elements so that the features of the relay can be accessed and setting changes can be done locally for configuration software.
 - At least 20 character alphanumeric backlit LCD display unit Fixed LEDs (for trip, Alarm, Relay available & Relay out of service) & programmable LEDs which can be assigned to Tactile keypad for browsing and setting the relay menu and protection function for local annunciation.
6. The minimum pickup threshold voltage of relay for 220 V DC systems must be min 138 V for binary input in order to prevent pick up during DC earth fault condition.
7. The relays supplied should be compatible to redundant communication architecture, shall be complied with the IEC 62439-3 standards of parallel redundancy protocol (PRP).
8. The relays provided should be complied with the international standards of NERC CIP or BDEW for cyber security to provide protection against unauthorized disclosure, transfer, modification, or destruction of information and/or information systems, whether accidental or intentional.
9. All PCB used in relays should have harsh environmental tested as per standard IEC 60068-2 (HEC) to increase the particle repellence and thereby increasing the life of relay.
10. The offered relays shall be completely numerical and should comply with 'IEC61850 Edition 2' protocol. The relay must support following requirements for communication ports and protocols,
 - The relays shall generate GOOSE messages as per latest IEC 61850 standards for interlocking and also to ensure interoperability with third party relays.
 - The relay must have front RS232/USB/RJ45 port for local communication with the device
 - The communication protocol shall be as per 'IEC61850 Edition 2'
 - The relay should be compatible to redundant communication architecture and shall be complied with IEC 62439-3 standards of parallel redundancy protocol (PRP)
 - The relays shall generate GOOSE messages as per IEC 61850 standards for interlocking and also to ensure interoperability with third party relays.
 - Necessary user friendly configuration tool shall be provided to configure the relays. It should be compatible with SCL/SCD files generated by a third party system.
 - GOOSE signals shall be freely configurable for any kind of signals using graphic tool/user friendly software.
 - The offered relay must support at least 4 no's or more of 61850 clients
 - The relay must support time synchronization through SNTP/IRIG B demodulated.
 - The relays provided should be complied with the international standards of NERC CIP or BDEW for cyber security to provide protection against unauthorized disclosure, transfer, modification, or destruction of information and/or information systems, whether accidental or intentional.
 - The relay settings shall be provided with adequate password protection. The password of the relay should be of 4 character upper case text to provide security to setting parameter.

11. The relays shall have the following tools for fault diagnostics
 - Fault record – The relay shall have the facility to store at least 5 last fault records with information on cause of trip, date, time, trip values of electrical parameters.
 - Event record – The relay shall have the facility to store at least 200 time stamped event records with 1ms resolution.
 - Disturbance records – The relay shall have capacity to store the waveforms for
 - A minimum duration of at least 5 secs with settable pre and post fault duration times at a minimum sampling rate of 800 Hz or Higher.
 - Except for differential protection the disturbance recorder must have capability to capture at least 8 analogue channels (IA, IB, IC, IN, VA, VB, VC, and VN) and 15 digital channels (start of protection element, trip of protection element, binary input, trip output etc) selectable at site.
 - For differential protection relay, the disturbance recorder must have capability to capture at least 12 analogue channels and 30 digital channels.
 - Necessary software shall be provided for retrieving and analyzing the records.
12. The relay settings shall be provided with adequate password protection. The password of the relay should be of at least 4 character to provide security to setting parameter
13. The relay shall have comprehensive self-diagnostic feature. This feature shall continuously monitor the healthiness of all the hardware and software elements of the relay. Any failure detected shall be annunciated through an output watchdog contact. The fault diagnosis information shall be displayed on the LCD and also through the communication port.
14. The Numerical Relays shall be provided with 1 Set of common support software compatible with both Windows 7 and higher which will allow easy settings of relays in addition to uploading of event, fault, disturbance records, and measurements.
 - The relay settings shall also be changed from local or remote using the same software.
 - Additional functions can be added to relay by software up gradation and downloading this upgraded software to the relays by simple communication through PC.
15. All protective relays shall be in draw out or plug-in type/modular cases with proper testing facilities. Necessary test plugs/test handles shall be supplied loose and shall be included in contractor's scope of supply.
16. All AC operated relays shall be suitable for operation at 50 Hz. AC Voltage operated relays shall be suitable for 110 Volts VT secondary and current operated relays for 1 amp CT secondary. All DC operated relays and timers shall be designed for the DC voltage specified, and shall operate satisfactorily between 80% and 110% of rated voltage. Voltage operated relays shall have adequate thermal capacity for continuous operation.
17. The protective relays shall be suitable for efficient and reliable operation of the protection scheme described in the specification. Necessary auxiliary relays and

timers required for interlocking schemes for multiplying of contacts suiting contact duties of protective relays and monitoring of control supplies and circuits, lockout relay monitoring circuits etc. Also required for the complete protection schemes described in the specification shall be provided. All protective relays shall be provided with at least two pairs of potential free isolated output contacts. Auxiliary relays and timers shall have pairs of contacts as required to complete the scheme; contacts shall be silver faced with spring action. Relay case shall have adequate number of terminals for making potential free external connections to the relay coils and contacts, including spare contacts.

18. Timers shall be of solid state type. Time delay in terms of milliseconds obtained by the external capacitor resistor combination is not preferred and shall be avoided.
 - a. No control relay, which shall trip the power circuit breaker when the relay is de-energized, shall be employed in the circuits.
 - b. Provision shall be made for easy isolation of trip circuits of each relay for the purpose of testing and maintenance.
 - c. Auxiliary seal in units provided on the protective relays shall preferably be of shunt reinforcement type.
 - d. The setting ranges of the relays offered, if different from the ones specified shall also be acceptable if they meet the functional requirements.
19. Any alternative/additional protections or relays considered necessary for providing complete effective and reliable protection shall also be offered separately. The acceptance of this alternative/ additional equipment shall lie with the OPTCL
20. The relay must be able to continuously measure following parameters with a typical accuracy of $\pm 1\%$.
 - Current (0.05 to 3 In) $\pm 1.5\%$ of reading,
 - Voltage (0.05 to 2 Vn) $\pm 1.0\%$ of reading
 - Frequency (40 to 70 Hz) ± 0.03 Hz
 - Phase 0° to 360° $\pm 5.0\%$
 - Power (W) $\pm 5.0\%$ of reading at unity power factor
 - Reactive power (VARs) $\pm 5.0\%$ of reading at zero power factor
 - Apparent power (VA) $\pm 5.0\%$ of reading

PROTECTION SYSTEM:

Protection discrimination:

On the occurrence of a fault on the power system network the high speed discriminating protection systems (main protection) shall rapidly detect the fault and initiate the opening of only those circuit breakers which are necessary to disconnect the faulted electrical element from the network. Protection equipment associated with adjacent electrical elements may detect the fault, but must be able to discriminate between an external fault and a fault on the electrical element which it is designed to

protect. Sequential time delayed tripping is not permitted except in the following specific circumstances:

- Protection for short connections between post current transformer housings and circuit breakers when the technical advantages of complete overlapping of the protection are outweighed by economic considerations, (i.e. short-zone protection)
- Operation of time graded back-up protection takes place as a result of either the complete failure of the communication links associated with the main protection systems, or the fault resistance is substantially greater than a value which can be detected by main protection systems.
- Operation of line back-up protection to disconnect primary system faults in the case of a circuit breaker failing to operate, (i.e. circuit breaker failure protection)
- All back-up protection systems shall be able to discriminate with main protection systems, circuit breaker fail protection and with other back-up protection systems installed elsewhere on the transmission system.

Protection settings:

A list of the settings to be applied to all protection systems together with all associated calculations, shall be provided for review and approval not less than three months prior to the first programmed date for commissioning. The settings for line protection shall be such as to permit correct operation of the protection for earth faults with up to 100 ohms fault resistance. Any limitations imposed on the power system as a result of the settings proposed shall be explicitly stated. In the absence of system data required for calculation purposes, assumptions may be made providing these are clearly identified as such in the relevant calculations.

Fault clearing time:

The protection equipment shall be capable of achieving the following discriminative fault clearing times, inclusive of circuit breaker and signalling times:

- One millisecond for all electrical elements whose boundary connections are defined by circuit breakers located within a given substation.
- For interconnecting tie lines in which the boundary connections of the electrical element being protected are defined by circuit breakers located in adjacent switching stations, an additional 20ms fault clearance time is allowed at the substation remote from the fault point. This additional fault clearance time is permitted subject to the requirement that the positive sequence impedance of the primary circuit from the switching terminal to the point of fault shall not be less than ten ohms.

The Contractor shall supply the Project Manager with details of the operating times under defined conditions of all protection equipment proposed. Any limitation in operating time performance shall be declared by the Contractor, e.g. end of zone faults where distance protection is applied, high resistance faults, faults at high X/R with significant DC component and time constant, faults coincident with communication channel noise. The Contractor shall specify the increase in operating time which could

occur under such conditions.

Signalling equipment operating times:

For design purposes the operating times of signalling equipment to provide a contact signal for use with associated distance protection shall be assumed to be as follows:

- | | |
|---|-----------------------|
| • Intercropping (transfer trip) not greater than: | 20 milliseconds |
| • Permissive transfer trip: | 15 to 20 milliseconds |
| • Blocking signal operate time: | 10 milliseconds |
| • Blocking signal reset time: | 10 milliseconds |

PROTECTION SCHEMES:

Line protection:

General requirement for line protection relays:

The line protection relays shall protect the line and clear faults on line in the shortest possible time with reliability, selectivity and full sensitivity to all types of line fault. The general concept for

1. 220kV level is to have primary and back-up protection systems having equal performance requirement especially in respect of time as would be provided by two Main protections called Main-I and Main-II. It is desirable that Main-I and Main-II protection should work on two different principles of operation and one back up dir O/C & E/F protection is envisaged.
2. For 33 kV level, the requirement is that of modular directional O/C and E/F protection.

The protection requirements are summarised below, and illustrated in the single line diagrams in the schedules.

220kV line:

- Main I Numerical non switched distance protection meeting performance levels.
- Main II Numerical non switched phase comparison, carrier aided or of numerical distance using a different principle of operation
- Phase segregated tele protection facility
- Power swing detection blocking and tripping
- Synchronizing.

- Line overvoltage (Only for 400kV and 220kV Line : 200kM Long)
- Auto reclosure
- Numerical directional over current and earth fault
- Three phase to ground
- Numerical local breaker back up
- Pole discrepancy protection

Distance Protection Relay:

- a. The IEC 60255-121 standard “Functional requirements for distance protection” published in March 2014, specifies the minimum requirements for functional and performance evaluation of distance protection relays, describes the tests to be performed and how to publish the test results. The relay should conform to above standard.
- b. The protection should be fully numerical and be based on a non-switched scheme.
- c. Provide protection for the transmission line from all types of faults-phase to earth faults as well as multiphase faults. The protection algorithm shall have dual redundant distance protection algorithms to detect all types of power system faults so as to arrive at a secure trip decision with correct phase selection and proper direction discrimination in the shortest possible time.
- d. The protection should have non-switched measurement, which implies processing of six possible fault loops (six –loop measurement).
- e. It should have polygonal characteristics with independently adjustable reactive and resistive reaches for maximum selectivity and maximum fault resistance coverage. The zones shall have independent settable earth fault compensation factors to cater to adjacent lines with different zero sequence to positive sequence ratios.
- f. Selection shall be so that the first zone of the relay can be set to about 80% - 85% of the protected line without any risk of non-selective tripping.
- g. The second and third zone elements shall provide backup protection in the event of the carrier protection or the first zone element failing to clear the fault, zone-2 shall cover full protected section plus 50 % of the next section; zone-3 shall normally cover the two adjacent sections completely.
- h. It must have load encroachment features and must support blocking of the selected zones during heavy load condition.
- i. It should have adequate number of forward zones (minimum three) and a reverse zone. The zone reach setting ranges shall be sufficient to cover line lengths appropriate to each zone. Carrier aided scheme options such as permissive under reach, over reach, & blocking and non-carrier aided schemes of zone 1 extension and Loss of load accelerated tripping schemes shall be available as standard. Weak in feed logic and current reversal guard also shall be provided.
- j. In case the carrier channel fails, one out of the non-carrier based schemes cited above should come into operation automatically to ensure high speed and simultaneous opening of breakers at both ends of the line.
- k. In addition to the conventional impedance measuring algorithm the distance

protection relay should have a separate measuring technique in the same hardware completely different to the conventional impedance measuring principal. Both the algorithms should run in parallel and should take trip decisions independently.

- l. Have a maximum operating time up to trip impulse to circuit breaker (complete protection time including applicable carrier and trip relay time) with CVT being used on the line :
 - For SIR 0.01-4 : as 35ms at the nearest end and 55ms at the other end of line
 - For SIR 4-15 : as 40ms at the nearest end and 60ms at the other end of line
 - With carrier transmission time taken as 18ms.
 - Relay should have sub cycle tripping facility for any zone1 fault i.e. max. Relay operating time for any zone 1 fault should not be more than 19ms.
- m. Have a secure directional response under all conditions, achieved by memory voltage polarizing and/or healthy phase voltage polarizing as appropriate.
- n. Shall have an independent Directional Earth Fault (DEF) protection element to detect highly resistive faults. This element shall have an inverse time/definite time characteristic with a possibility to configure the DEF as a channel-aided DEF or a channel-independent DEF.
- o. Have logic to detect loss of single/two phase voltage input as well as three phase voltage loss during energisation and normal load conditions. The voltage circuit monitoring logic should in addition to blocking the distance protection element, enable an emergency over current element to provide a standby protection to the feeder till the re-appearance of voltage signal.
The VT fuse failure function shall function properly irrespective of the loading on the line. In other words the function shall not be inhibited during operation of line under very low load conditions.
- p. Have necessary logic to take care of switch-on-to-fault condition. Energisation of transformers at remote line ends and the accompanying inrush current shall not cause any instability to the operation of relay.
- q. The line protection IED should have power swing blocking feature, with facilities for :
 - i. fast detection of power swing
 - ii. selective blocking of zones
 - iii. Settable unblocking criteria for earth faults, phase faults and three phase faults.
- r. Also the Distance protection IED should have following features in built in it.
 - Suitable for single pole or three pole tripping.
 - Shall have inbuilt CT supervision facility. A time-delayed alarm shall be issued if a CT open circuit is detected.
 - Shall have inbuilt Trip circuit supervision facility to monitor both pre- and post-close supervision facilities. An alarm shall be generated.
 - Shall have inbuilt Circuit Breaker Failure protection based on undercurrent detection and/or circuit breaker auxiliary contact status and/or distance protection reset status. Provision shall be given to initiate the breaker fail logic using a digital input from external protection devices.
 - Shall have inbuilt in broken conductor detection by measuring the ratio of I2 & I1. The sensitivity of the logic shall not be affected during operation under low load.
 - Shall have a fault locator with an accuracy of $\pm 3\%$. The display shall be in kilometres, miles or percentage impedance. The fault locator should have built in mutual compensation for parallel circuit.
- s. Be capable of performing basic instrumentation functions and display various

- instantaneous parameters like Voltage, current, active power, reactive power etc. in primary values. Additionally all sequence current and voltage values shall be displayed on-line. Also the direction of power flow shall be displayed.
- t. The relay shall have a built-in auto-reclose function with facilities for single pole / three poles / single and three pole tripping. It shall be possible to trigger the A/R function from an external protection. A voltage check function which can be programmed for dead line charging/dead bus charging / check synchronising shall be included.
 - u. Records containing discrete data on the last five faults shall be made available. In particular the fault resistance value shall be available for each record.
 - v. Facility for developing customized logic schemes inside the relay based on Boolean logic gates and timers should be available. Facility for renaming the menu texts as required by operating staff at site should be provided.
 - w. The protection relay should have the following additional elements
 - i. Under / over voltage protection. The relay shall have two stages of voltage protections where each stage can be set as under/over voltage. The drop off/Pickup ratio can be set up to 99%.
 - ii. The relay shall have built in Circuit Breaker Supervision Functions for Condition based Circuit Breaker Maintenance
 - iii. The relay shall be able to detect any discrepancy found between NO & NC contacts of breaker
 - iv. The relay shall monitor number of breaker trip operations
 - v. The relay shall record the sum of the broken current quantity
 - vi. The relay shall also monitor the breaker operating time
- In all the above cases the relay shall generate an alarm if the value crosses the threshold value.

Numerical transformer differential relay:

- a. **General requirements for transformer protection scheme : The differential protection IED**
 - The offered relay must be suitable providing complete protection for 2 winding transformer, 3 winding transformer and auto transformer
 - **Category-A:** For 3 winding differential Protection, it must have 12 CT input, 3 for phase CT HV side, 3 for phase CT LV side, 3 for Phase CT TV side, 1 for neutral CT HV, 1 for neutral CT LV, 1 for neutral CT TV.
 - **Category-B:** For 2 winding differential protection, it must have 8 CT input, 3 for phase CT HV side, 3 for phase CT LV side, 1 Neutral CT HV side, 1 Neutral CT LV side.
 - The relay must be suitable for providing low impedance REF protection for auto transformer.
 - For 2 winding & 3 winding transformer 4 VT inputs are required.
 - The protection function requirement for Transformer protection relays are as mentioned below,
 - Differential protection (Low Impedance type with 3 slope characteristic)
 - 2 elements of REF Protection for 2 winding transformer and must have option of Low Impedance and High impedance REF as per the site requirements.
 - 3 elements of REF protection for 3 winding transformer and must be selectable between Low and High impedance REF

- REF protection for autotransformers.
- Backup Over current and Earth fault for each winding
- Thermal overload protection
- Over excitation protection
- Over and Under frequency protection
- CB Fail protection for each Winding (CT) input
- Shall be stable during magnetizing inrush and over fluxing conditions. Stabilization under inrush conditions shall be based on the presence of second harmonic components in the differential currents. The second harmonic blocking threshold shall be programmable one.
- Shall have facility to deactivate harmonic restraint and over fluxing restraint functions.
- Shall have saturation discriminator as an additional safeguard for stability under through fault conditions.
- The relay should be capable of detecting the CT saturation. Relay should use appropriate algorithm to detect light saturation condition.
- It shall be possible in the relay to individually set MVA rating of transformer per winding.
- Relay should have vector group and magnitude correction. Relay should have facility for filtering zero seq. current for stability of transformer differential protection (87T) during through fault.
- Thermal overload protection as per IEC 60255.
- The relay shall have through fault monitoring element to monitor the HV, the LV or the TV winding to give the fault current level, the duration of the faulty condition, the date & time for each through fault.
- The relay shall have REF protection, be selectable separately for each winding and programmable as either high or low impedance. The REF function should be able to share CT's with the biased differential function. The REF protection provided should be suitable for auto transformer also.
- Shall have all output relays suitable for both signals and trip duties.
- Shall be stable during magnetizing inrush and over fluxing conditions. Stabilization under inrush conditions shall be based on the presence of second harmonic components in the differential currents. The second harmonic blocking threshold shall be programmable one.
- Shall have facility to deactivate harmonic restraint and over fluxing restraint Functions.
- Shall have saturation discriminator as an additional safeguard for stability under through fault conditions.
- Shall have software for interposing current transformers for angle and ratio correction to take care of the angle & ratio correction.
- Shall have all output relays suitable for both signals and trip duties.
- Shall have transient bias to enhance the stability of differential element during external fault condition.
- The relay should have combined harmonic blocking and restraint features to provide maximum security during transformer magnetizing inrush conditions

Functional Description:

i. Differential Protection:

- The relay shall be biased differential protection with triple slope tripping characteristics with faulty phase identification / indication. The range for the differential pick-up shall be from 0.1 to 2.5pu. Its operating time shall not exceed 30ms at 5 times rated current.
- The relay shall have adjustable bias slopes m_1 from 0 % to 150 % and slope m_2 from 15% to 150 % so as to provide maximum sensitivity for internal faults with high stability for through faults.
- The relay shall have an unrestrained highest element to back up the biased differential function and the setting range for it shall have a minimum setting of 5pu and a maximum setting of 30pu.
- The relay shall have the stability under inrush conditions. The ratio of the second harmonic component to the fundamental wave for the differential currents of the measuring system shall serve as the criterion.
- The device shall have reliable detection technique, preferably no gap detection technique to ensure stability during inrush. Any type of time delay is not acceptable to differentiate inrush and fault condition.
- The relay shall provide restraint for over fluxing condition for the transformer by measuring the ratio of the fifth harmonic to the fundamental for the differential current if subjected to transient over fluxing. The fifth harmonic blocking feature should have variable percentage setting.

ii. Restricted Earth fault Protection (64 R):

This function should be provided to maximise the sensitivity of the protection of earth faults. The REF function should be selected separately for each winding and programmable as either high or low impedance. The REF function should be able to share CT's with the biased differential function. As in traditional REF protections, the function should respond only to the fundamental frequency component of the currents. The REF protection provided should be suitable for auto transformer also.

iii. Over fluxing Protection (99 GT):

The relay shall over fluxing protection Volts/Hertz protection to the transformers protected. By pairs of v/f and t , it shall be possible to plot the over fluxing characteristics in the relay so that accurate adaptation of the power transformer Over fluxing characteristics is ensured. In addition the relay should have a definite time element for alarm. The reset ratio for over fluxing Protection shall be 98%.

iv. Overload Protection:

Shall have thermal overload protection for alarm and trip condition with continuously adjustable setting range of 10-400% of rated current

v. Over current Protection (50,51):

The relay shall have three stages of definite time over current protection as backup operating with separate measuring systems for the evaluation of the three phase currents, the negative sequence current and the residual current. In addition the relay shall have three stages of Inverse time over current protection operating on the basis

of one measuring system each for the three phase currents, the negative sequence current and the residual current.

vi. Over / Under frequency:

The relay shall have four stages of frequency protections where each stage can be set as under/over frequency, under/over frequency.

vii. Over / Under Voltage:

The relay shall have two stages of voltage protections where each stage can be set as under/over voltage. The adjustable drop off/Pickup ratio better than 97% should be available.

viii. Local Breaker Back up protection:

The relay shall in built LBB protection to detect the failure in the local breaker using the undercurrent criteria and trip the upstream breaker.

FEEDER MANAGEMENT RELAY:

Protection and Control function requirements for feeder Management Relay:

- The Relay provides the following current based protection functions:
- Phase/Neutral/Ground instantaneous over current
- Phase/neutral/ground time over current
- Negative sequence Timed over current
- Phase/neutral directional over current
- Restricted Ground Fault (87REF)
- Breaker Failure (50BF)
- Thermal Model (49)
- Cold Load Pickup (CLP)
- The Relay provides the following voltage based functions:
- Phase Over and Under Voltage
- Neutral Over Voltage
- Directional Power
- Forward Power
- The Relay provides the following control functions:
- 4 Shot Auto Reclose (79)
- VT Fuse failure (VTFF)
- Over/Under Frequency (81O/81U)
- Rate of change of Frequency (81df/dt)
- Synchro check (25)
- Breaker Failure (50BF)
- At least 5 user configurable commands for local and remote (Remote through SCADA on MMS)
- Configurable Single line diagram for the substation bay.
- The relay should have 2 switchable setting groups for dynamic reconfiguration of the protection elements due to changed conditions

- Programmable LOGIC
- Relay supports user defined logic to build control schemes supporting logic gates, timers, non-volatile latches.
- The Relay configuration tool has an embedded graphical user interface to build programmable logic.

Front-Panel Visualization:

- The front panel includes user-programmable LEDs and pushbuttons and navigation keys.
- For bay information that includes user programmable screens for:
 - Single line diagram displaying
 - Switchgear operation
 - Access to metering information
 - Alarm panel display.
 - I/O status display.
 - Relay settings

BACKUP RELAYS (Current Protection):

The combined over current and earth-fault relay is connected to the current transformers of the object to be protected. The over current unit and the earth-fault unit continuously measure the phase currents and the neutral current of the object. On detection of a fault, the relay will start, trip the circuit breaker, provide alarms, record fault data, etc., in accordance with the application and the configured relay functions.

i. Functional description:

(a) Three-Phase Over current (50/51) & Earth Over current (50N/51N)

Three independent stages are available either for phase and earth fault protection. For the first and second stage the user may independently select definite time delay (DTOC) or inverse time delay (IDMT) with different type of curves (IEC, IEEE/ANSI, IS 3231:1987).

(b) Three-Phase & Earth-Fault Directional Over current (67/67N)

Each of the three-phase over current stages & earth fault stages can be independently configured as directional protection and with specific characteristic angle (RCA) and boundaries as per IEC, IEEE/ANSI, IS . The phase fault directional elements should be internally polarised by quadrature phase to phase voltages. A synchronous polarising function or any other suitable algorithm may be provided to ensure a correct operation of the over current elements for close-up three phase faults where the collapse of the polarising line voltages occurs.

(c) Under / Over Voltage (27/59)

Independent under-voltage stage and two or more over-voltage stages may be provided. They should be definite time elements. Each stage can be configured to operate from either phase-neutral or phase-phase voltages. The drop off to pick up ratio should be 99.5%.

(d) Under / Over Frequency (81U/O)

Time delayed under and over frequency protection on the fundamental form of frequency protection is to be provided when the frequency measured is crossed 6 pre-defined thresholds, the relays should generate a start signal and after a user settable time delay, a trip signal.

(e) Circuit Breaker Failure Protection (50BF):

The circuit breaker failure verifies the effective opening of the CB by a dedicated undercurrent threshold. The circuit breaker failure function can be activated by trip of a generic protection or/and external command by the relevant digital input. The circuit breaker failure protection can be used for tripping upstream circuit breakers too.

BUS BAR PROTECTION:

Bus bar protection schemes shall be provided for each main bus of 200kV provided in the GIS S/S. This shall constitute main and check features. The overall scheme shall be engineered such that operation of both main and check features connected to the faulty bus shall result in tripping of the same. The scheme shall be provided with necessary expansion capacity and interfaces for adding features when the switch yard is extended in future to its ultimate capacity. The bus bar relay shall be of latest numerical relay having IEC protocol 61850 compliance.

(a) Bus-bar protection (Latest version numerical having IEC-61850 protocol compliance)

Bus bar protection schemes shall be provided for each main bus of 220kV GIS S/S. The overall scheme shall be engineered so as to ensure that operation of any one out of two schemes connected to main faulty bus shall result in tripping of the same. However in case of transfer bus, where provided, only one bus-bar protection scheme shall be required.

(b) Each bus-bar protection scheme shall:

1. Be of modular construction and have features of self-monitoring facility to ensure maximum availability of scheme. The scheme shall be Numerical based.
2. Have maximum operating time up to trip impulse to trip relay for all types of faults of 15 mille seconds at 5 times setting value.
3. Operate selectively for each bus bar.
4. Give hundred percent securities up to 40kA fault level.
5. Incorporate a check feature.
6. Incorporate continuous supervision for CT secondary against any possible open circuit and if it occurs, shall render the relevant zone of protection inoperative and initiate alarm.
7. Not give false operation during normal load flow in bus-bars.
8. Incorporate clear zone indication.

9. Be of phase segregated and triple pole type and provide independent zones of protection for each bus (including transfer bus if any). If a bus section is provided then each side of the bus section shall have separate bus-bar protection scheme.
10. Include individual high speed hand reset tripping relays for each feeder, including future ones.
11. Be of low/medium impedance biased differential type and have operate and restraint characteristics.
12. Be transient free in operation
13. Include continuous DC supplies supervision.
14. Shall include multi tap auxiliary CT's for each bay including future bays as per SLD and also include necessary CT switching relays wherever CT switching is involved.
15. Include protection 'in/out' switch for each zone with at least six contacts for each switch.
16. Shall have CT selection incomplete alarm wherever CT switching is involved.
17. Have necessary auxiliary relays to make a comprehensive scheme. At existing substations bus-bar scheme with independent zones for each bus will be available. All necessary co-ordination for 'CT' and 'DC' interconnections between existing schemes (panels) and the bays proposed under the scope of this contract shall be fully covered by the bidder. Any auxiliary relays, trip relays, flag relays required to facilitate the operation of bays covered under this contract shall be fully covered in the scope of the bidder.

TIME SYNCHRONIZATION EQUIPMENT FOR SUBSTATION:

The Bidder shall offer necessary time synchronisation equipment complete in all respects including antenna, all cables, processing equipment etc. required to receive co-ordinated universal time (UTC), transmitted through GEO Positioning Satellite System (GPS).

The time synchronising system should be compatible for synchronisation with event loggers, disturbance recorders, relays, computer systems and all other equipment provided in the protection, control and metering system of the substation wherever required.

Equipment should operate up to an ambient temperature of 50C and 100% humidity. The synchronisation equipment shall have two microsecond accuracy. Equipment should give real time corresponding to IST (taking into consideration all factors such as voltage and temperature variations, propagation and processing delays etc.

Equipment should meet the requirement of IEC 255 for storage and operation. The system should be able to track the satellites to ensure no interruption of synchronisation signal.

The output signal from each port shall be programmable at site for either one hour, half hour, minute or second pulse, as per requirement.

The equipment offered shall have six output ports. Various combinations of output ports shall be selected by the Project Manager, during detailed engineering, from the following:

1. Voltage signal: 0-5V continuously settable, with 50ms. minimum pulse duration.
2. Potential free contact : minimum pulse duration of 50 ms
3. IRIG-B OR SNTP
4. RS232C
5. The equipment should have a periodic time correction facility of one second periodicity.

Time synchronisation equipment shall be suitable for operation from 220V DC as available at substation with a voltage variation of +10% and -20%. Any other power supply that may be required for proper functioning of the equipment shall be derived by the Bidder from his own equipment which shall form an integral part of the system.

Equipment shall have real time digital display in hour, minute, second (24 hour mode) and have a separate time display unit to be mounted on the top of panels having display size of approximately 100mm height.

No. of Devices in different protection panels:

(a) Line Feeder Protection Panel:

The line protection panel or panels may be a single panel or more panels to accommodate all the equipment listed below.

Sl. No	Equipment	Quantities Required	
		220kV	33kv
1	Main-I protection scheme (composite numerical distance protection relay with auto reclosing and check synchronising facility)	1 set	Not required
2	Main-II protection scheme (composite numerical distance protection or phase comparison relay with auto reclosing and check synchronising facility)	1 set	Not required
3	Composite numerical directional & or non-directional over current and earth fault relay.(selectable Features Dir & Non Dir)	1 set	1 set
4	Over voltage/ Under voltage/Frequency protection scheme (if not available in the main-I& II or Back-up protection relay)	1 set	1 set
5	Selector switch for carrier in/out for main-I and main-II protection scheme	2 Nos.	Not required

7	Disturbance recorder (if not available in the main-I& II and Back-up protection relay)	1 set	1set
8	Distant-to-fault locator for phase and earth faults(if not available in the distance protection or main protection module)	1 set	Not required
9	CVT/VT selecting relays or switches (depending on switching scheme)	1set	Required for two us scheme
10	Test terminal blocks for Main-I/ Main II/other protection relay	1 set for each module	1 set for each module
11	Auxiliary relays for carrier supervision of Main-I and Main II protection relays (depending on its application)	1 set	Not required
12	Carrier receive lockout relay (depending on its application)	1 set	Not required
13	Breaker failure protection scheme (if not available in the main-I& II or Back-up protection relay)	1 set	1 set
14	Trip circuit pre and post-supervision relays for trip coil I and II	1 set	1 set
15	DC and AC supply supervision relay	1 set	1 set
16	Electrical reset relays for circuit breaker trouble shooting	1 set	1 set
17	Trip relays single/three phase for group-A	1 set	1 set
18	Trip relays single/three phase for group-B	1 set	1 set
19	Trip relays single/three phase for LBB	1 set	1 set
20	Under Frequency Relay(in built feature of Main-I&II or O/C & E/F relay)	1 set	1 set

21	Numerical Bay Control Unit of adequate BI, BO, Transducers etc., as per the site requirement & detailed Engg. Done.	1 No	* 1 No * BCPU Can be considered.
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(b) Transformer Protection Panel:

The transformer protection panel or panels may be a single panel or more panels to accommodate all the equipment listed below.

Sl. No	Equipment	Quantities Required	
		For each High Voltage panel of 220/33kV transformers	For each Low Voltage Panel of transformers
1	Main-I Transformer composite numerical protection comprising of the following: Differential protection earth fault protection Over fluxing protection	1 set	Not required
2	Main-II Duplicated numerical protection as Main-I	Not required	Not required
3	Composite numerical directional over current and earth fault protection relay(selectable Features Dir & Non Dir)	1 set	1 set
	Numerical earth fault protection (high impedance with Stabilising resistor & metrosil)	1 set	1 set
4	Over load protection (if not included in sl.no. 1 ,2 & 3 above)	1 set	1 set
5	Over voltage / Under voltage/Frequency protection scheme (if not available in the main protection & back-up protection module)	1 set	1set

6	Auxiliary relays for thermal imaging, MOG, WTI, OTI, Buchholz, PRV, OSR and status indication etc.,(1.MOG-AI, 2.WTI, BUCH, OTI – AI & Trip, 3. PRV,OSR – Trip)	1 set	Not required
7	CVT/PT selection relays (depending upon the switching scheme of the system)	1 set	1 set
8	Breaker failure protection scheme (if not available in the main protection & back-up protection module)	1 set	1 set
9	Trip circuit pre and post-supervision relays for trip coil I and II.	1 set	1 set
10	DC / AC supply supervision relay	1 set	1 set
11	Aux relays for circuitbreaker trouble shooting	1 set	1 set
12	Trip relays three phase for group- A	1 set	1 set
13	Trip relays three phase for group- B	1 set	1 set
14	Test terminal blocks for all protection relays	1 set for each module	1 set for each module
15	Numerical Bay Control Unit of adequate BI, BO, Transducers etc as per the site requirement & detailed Engg. done.	1 No	1 No BCPU can be considered.

(c) Bus coupler and Bus bar protection panel

Bus bar protection panel shall be equipped to accommodate all present and future bays.

Sl. No	Equipment	Quantities Required	
		220kV	33kv

1.	Composite numerical Directional Over current and earth fault protection (selectable Features Dir & Non Dir)	1 set	1 set
2.	Test terminal block for all protection relays	1 set for each module	1 set for each module
3.	Trip circuit pre and post-supervision relays for trip coil I and II	1 set	1 set
4.	DC supply supervision relay	1 set	1 set
5.	Flag relays for circuit breaker trouble and status indication etc.	1 set	1 set
6.	Breaker failure protection scheme	1 set	1 set
7.	Trip relays single/three phase for group-A	1 set	1 set
8.	Trip relays single/three phase for group-B	1 set	1 set
9.	Numerical Bus bar differential relay for Bus-1, Bus-II and Transfer Bus (if required depending on the Bus configuration) having check zone features with SCADA compatibility.	1 set	Not required
10.	Numerical Bay Control Unit of adequate BI, BO, Transducers etc as per the site requirement & detailed Engg. done.	1 No	1 No BCPU can be considered

NOTE: Any other protection device/relays/equipment besides above required to complete the scheme as per standard practice of OPTCL are also required to be considered. The SAS shall be in the PRP based.

RELAY TEST KIT:

- (a) One relay test kit of OMICRON make (latest model & to be decided during detailed Engineering) suitable for conducting testing of protection devices with different techniques, report preparation, memory etc., duly adopted to be provided. (Optional, if specifically asked in tender BOQ)

- (b) Other tools as required for testing, attending to the troubles in the panel, suitable screwdriver set, nose plier/plier set, cutter, soldering kits, testing cords, etc: 3 Sets
- (c) Test plugs: 2 set.

PART-6
OUTDOOR 220kV
Metering Current Transfrmer

TECHNICAL SPECIFICATION FOR 220kV OUTDOOR CURRENT TRANSFORMER

1.0 STANDARDS:

The scope covers design, engineering, manufacturing, assembly and supply of Single phase 220kV current transformer for 220/33kV TFL Substation.

Bidders may note that 220kV Current transformer shall be manufactured, tested and supplied with all guaranteed technical particulars generally conforming to meet the requirement of this technical specification and latest revisions of relevant standards of international electro technical commission or equivalent national standards of India with latest amendments of relevant standards rules and codes.

S No.	Indian Standards	Title	International Standards
1	IS:2165	Insulation Co-ordination for equipment of 1 kV and above.	-
2	IS:2705 (Part I to IV)	Current Transformers	IEC 61869-2
3	IS:2099	Insulated Bushings for alternative voltage above 1000 V	IEC-60137
4	IS:2071 (Part III)	Method of High Voltage Testing – Measuring devices.	-
5	IS:335	Insulating oil for transformers and switchgears	-
6	-	High-voltage test techniques – Partial Discharge Measurement	IEC-600270
7	-	Instrument Transformer - Measurement of PDs	IEC-60044-4
8	-	Insulation co-ordination	IEC-60071
9	-	High voltage testing techniques	IEC-60060
10	-	Radio Interference Voltage test on high voltage insulators	IEC-60437
11	-	Indian Electricity Rules 1956.	-
12	IS:5561	Electrical Power Connector	-
13	IS:4800	Enameled Round Winding Wires	-

14	IS:2629	Recommended practice for hot dip galvanizing of Iron & Steel	-
15	-	Fluids for electro technical applications – Unused mineral insulating oils for transformer & switchgear.	IEC-60296
16	-	Guide for selection of Insulators in polluted conditions	IEC-60815
17	OISD - RP - 149	Design aspects for safety in electrical system	-
18	OISD – STD – 173	Fire prevention and protection system for electrical installations	-

1.1 If the equipment offered by Bidders conforms to any other standards, salient points of comparison between the standards adopted and the specific standards shall be clearly brought out in relevant schedule of technical deviation. It will be sole responsibility of bidders to prove that the salient features of offered equipment are equivalent or better than IS.

1.2 Metering current transformer shall be used for metering purpose of TFL SS, **Shall be of 5 cores (4 PS Class & 1 Metering Class).**

1.3 The bidder shall also note that list of standards presented in this specification is not complete. Wherever necessary the list of standards shall be considered in conjunction with specific IS/IEC.

1.4 When the specific requirements stipulated in the specifications exceed or differ than those required by the applicable standards, the stipulation of the specification shall take precedence.

1.5 The equipment conforming to standards other than specified above shall be subject to TFL approval.

2.0 BASIC DESIGN AND TECHNICAL REQUIREMENTS

2.1 BASIC DESIGN:

The 220kV Current transformer shall be dead tank/live tank type & shall have single primary either ring type, or hair pin type or bar type and suitably designed for bringing out the secondary terminals in a weather proof (IP 55) terminal box at the bottom. The top dome shall have oil level gauge/ pressure relief device etc., The equipment shall be outdoor, single phase oil immersed and self-cooled type suitable for services indicated as above complete in all respect, conforming to modern practices of design and manufacture.

Current Transformer with cascade design/ interposing CTs/auxiliary CTs are not acceptable.

As stated, all Current transformers shall be paper insulated, oil filled type. Please note

epoxy casting in primary & secondary cores is not acceptable. The compound filled CTs are also not acceptable. Manufacturers should briefly describe complete process of manufacturing.

The insulation shall be as per latest version of IS: 4800 or equivalent International standard shall be so designed that the internal insulation shall have higher electrical withstand capability than the external insulation. The designed dielectric withstands values of external and internal insulations shall be clearly brought out in the guaranteed technical particulars. The dielectric withstand value are meant for fully assembled current transformers. The class of insulation shall be Class A.

The Current transformers covered under this specification shall meet the technical requirements indicated in Annexure-1 enclosed with the specification.

2.2 PORCELAIN HOUSING:

The Current transformer should be designed using single porcelain housing. No joints shall be provided in the porcelain. The housing shall be made of homogeneous, vitreous porcelain of high mechanical and electrical strength. Glazing of porcelain shall be of uniform brown or dark brown colour with a smooth surface arranged to shed away rain water or condensed water particles (fog). The profile of porcelain shall be aerodynamic type as per latest version of IEC-60815.

Details of attachment of metallic flanges to the porcelain shall be brought out in the Bid.

2.3 METAL TANK:

Special precaution will have to be taken towards selection of material for the metal tank and the following will have to be ensured.

- i. Material for metal tank which should be minimum 3 mm thick (i.e. mild steel/ stainless steel/ aluminium alloy) shall be carefully selected depending upon the primary current and the material should be clearly mentioned against technical questionnaire.
- ii. The practice of providing inserts of non-magnetic material in the body of the tank with suitable welding to reduce eddy current shall not be acceptable. This problem should be avoided by selection of tank of suitable material.
- iii. Welded joints have to be minimized to avoid possibility of oil leakage. In any case, welding in horizontal plane shall be avoided.
- iv. The slot / hole cutting in the bottom tank should be done smoothly to avoid any sharp edges within the tank. All welded surfaces need to be smoothed and shall be covered with pressboard or other insulating material of good mechanical properties.
- v. The bottom tank should not have any dents and pitting to ensure proper tightening of gasket and to avoid any oil leakage. Fabrication of bottom tank shall be done by utilizing fresh sheet steel only.

The material selected for the tank shall be justified with suitable explanation.

2.4 PREVENTION OF OIL LEAKAGES AND ENTRY OF MOISTURE:

The sealing of Current transformer shall be properly achieved. The following should be properly taken care of and arrangement provided by the successful Agency shall be described.

- i. Locations of emergence of primary and secondary terminals.
- ii. Interface between porcelain housing and metal tank.

iii. Cover of the secondary terminal box.

For gasket joints, wherever used, Nitrile Butyl Rubber gaskets, neoprene or any other improved material shall be used. The gasket shall be fitted in properly machined groove with adequate space for accommodating the gasket under compression. You have to submit complete details and justify that the quality of gaskets which will be used between the joints and also for mounting of oil level indicator will be of best quality to avoid leakage of oil.

The CT shall so constructed that it can be easily transported to site within the allowable transport limitation and in horizontal position if the transport limitations so demand. The CTs shall be hermetically sealed and method of such sealing shall be detailed out in the bid.

The live tank bar type CT will additionally meet following requirements.

- i The secondaries shall be totally encased in metallic shielding providing a uniform equipotential surface for even electric field distribution.
- ii The lowest part of the insulation assembly shall be properly secured to avoid any risk of damage due to transportation stresses.
- iii The upper part of insulation assembly resting on primary bar shall be properly secured to avoid any damage during transportation due to relative movement between insulation assembly & top dome.
- iv Nitrogen if used for hermetic sealing (in case of live tank design) should not come in direct contact with oil.
- v Successful Agency /Manufacturer shall recommend whether any special storage facility is required for spare CT.
- vi Different ratios specified shall be achieved by secondary taps only and primary reconnection shall not be accepted.
- vii The expansion chamber at the top of the porcelain insulators should be suitable for expansion of oil.
- viii Facilities shall be provided at terminal blocks in the marshalling box for star delta formation, short circuiting and grounding of CT secondary terminals.
- ix Current transformer's guaranteed burdens and accuracy class are to be intended as simultaneous for all cores.
- x The current transformer shall be suitable for horizontal transportation. It shall be ensured that the CT is able to withstand all the stresses imposed on it while transporting and there shall be no damage in transit the successful Agency shall submit the details of packing design to the Purchaser for review.
- xi The CT shall be designed as to achieve the minimum risks of explosion in service. Successful Agency /Manufacturer shall bring out in his offer, the measures taken to achieve this.

2.5 MOUNTING:

The Current transformer shall be suitable for mounting on steel structure.

2.6 INSULATING OIL:

The insulating oil for first filling of oil in each current transformer shall be in the scope of bidder. Only best quality new EHV Grade transformer oil should be used with the equipments with minimum BDV as per IS 335. The oil shall comply in all respect with the provisions of the latest version of IS: 335 and the requirements indicated below is determined in accordance with the test methods adopted by IS 335. The oil parameters shall be recorded in the test certificates of respective CT.

S.NO	CHARACTERISTICS	REQUIREMENTS	METHOD OF TEST
1	Appearance	The oil shall be clear, transparent and free from suspended matter or sediment.	A representative sample of oil shall be examined in a 100mm thick layer, at ambient temperature of equivalent authoritative standard.
2	Density at 29.5 °C Max.	0.89g / cm ³	IS: 1448 or equivalent Authoritative standard.
3	Kinematics viscosity at 27 °C Max.	27 CST	IS: 1448 or equivalent Authoritative standard.
4	Interfacial tension at 27 °C Min.	0.04 N / m	IS: 6104 or equivalent Authoritative standard.
5	Flash point Pensky-Marten (closed), Min.	140 °C	IS: 1448 or equivalent Authoritative standard.
6	Four point max.	-6 °C	IS: 1448 or equivalent Authoritative standard.
7	Neutralization value (Total acidity) max.	0.03mg/KOH/G	IS: 1448 or equivalent Authoritative standard.
8	Corrosive Sulphur (in terms of classification of copper strip)	Non – corrosive	IS: 335 or equivalent Authoritative standard
9	Electric strength (Break-down Voltage) Min. a) New untreated oil. b) After treatment	30kV (rms). If the above value is not attained, the oil shall be treated 60 kV (rms.)	IS: 6792 or equivalent Authoritative standard.
10	Dielectric dissipation factor (tan- delta) at 90 °C Max.	0.002	IS: 6262 or equivalent Authoritative standard.
11	Specific resistance (resistivity) a) At 90 °C Min b) At 27 °C Min.	35 x 10 ¹² ohm -cm 1500 x 10 ¹² Ohm-cm	IS : 6103 or equivalent Authoritative standard
12	Oxidation stability a) Neutralization value after oxidation, Max. b) Total sludge after oxidation, Max.	0.40 mg / KOH / g 0.1 percent by weight.	IS: 335 or equivalent Authoritative standard.

13	Ageing characteristics after accelerated ageing		
	a) Specific resistance (Resistivity).		
	i) At 27°C, Min.	2.5 x 10 ¹² ohm/cm.	IS : 6103
	ii) At 90°C, Min.	0.2 x 10 ¹² ohm/cm.	
	b) Dielectric dissipation factor (tanδ) at 90°C max	0.20	IS : 6262
	c) Total slug (Max).	0.05 mg. KOH/G	IS:6262
	d) Total slug value % by weight.	0.05 percent by weight	
14	Water content, Max	50 ppm.	IS: 2362 or equivalent Authoritative standard.

2.7 TEMPERATURE RISE:

The temperature rise of current transformer winding when carrying a primary current equal to rated continuous thermal current at a rated frequency and with a unity power factor burden corresponding to rated output connected at the secondary winding shall be 5 degree less than the values given in the latest version of IS: 2705 or equivalent international standard.

2.8 SECONDARY TERMINAL BOX:

The following may please be noted for strict compliance:

- (a) The C.T. secondary terminals shall be brought out in a weather proof terminal box. Firstly the connections will be terminated on an internal board and then the same shall be brought out in the outer Secondary terminal box. The secondary terminals should be bolted type suitable for wire size up to 4 sq. mm. of Copper for connection.
- (b) These secondary terminals shall be terminated to stud type non disconnecting terminal blocks inside the terminal box.
- (c) The terminal box shall be provided with removable gland plate and gland's suitable for 1100 volts grade, PVC insulated, PVC sheathed multi core 4.0 sq.mm. Stranded copper cable.
- (d) The terminal box shall have a degree of protection of IP55 as per the Standard IEC: 60529. Suitable arrangement shall be made for drying of air inside the secondary terminal box.
- (e) The dimensions of the terminal box and its openings shall be adequate to enable easy access and working space with use of normal tools.
- (f) The outer cover of secondary terminal box shall have provision for sealing by way of insertion of wire in the bolt hole. A drawing indicating above arrangement may please be furnished along with the bid.

For measuring tan delta values, separate tan delta test terminal shall be provided on the opposite side of secondary terminal box.

2.9 POLARITY:

Polarity shall be invariably marked on each primary and secondary terminal. Facility shall be provided for short circuiting & grounding of the CT secondary terminals inside the terminal box. All marking shall be engraved or through anodized plate which

should be firmly fixed.

2.10 RATING PLATE:

The C.T. shall be provided with a rating plate with dimensions and markings as per latest version of IS: 2705 / IEC-61869 (Part-2). The markings shall be punched/ engraved and not painted. In Addition to these, the following Specific points shall also be marked on rating plate.

- i) Purchase order number with date and item number, if any.
- ii) Connection Diagram, Polarity & Terminal markings.
- iii) Burden.
- iv) Knee point voltage & Magnetizing Current.
- v) Instrument Security Factor.
- vi) Secondary Winding Resistance.
- vii) Oil weight.
- viii) Total weight.

2.11 OIL FILLING AND SEALING:

The current transformer shall be Vacuum filled with oil after processing and thereafter hermetically sealed to eliminate breathing and to prevent air and moisture entering into the tanks. Oil sampling valve provided at the bottom of CT should be protected by providing metallic cover or blanking plug/ plate. Valve should be welded to avoid any leakage. Nitrogen filling valve should be fitted with an indicator and cap to prevent leakage of nitrogen. The method adopted for hermetic sealing shall be described in the bid.

2.12 EARTHING:

Current transformer shall be provided with two separate earthing terminals for bolted connection to GI flat will be provided by the Purchaser for connection to station earth-mat.

2.13 PRIMARY WINDING:

- (a) 220kV Current Transformer, Primary winding shall be made out of not less than 97% conductivity electrolytic grade copper conductor. Conductors used for the primary winding shall be rigid and housed in rigid metallic shell. Joints in the primary winding shall not be provided. For primary winding current density shall not exceed 1.65 Amp/sq.mm at continuous overloading of 20% above rated current.
- (b) The design density for short circuit current as well as conductivity of the metal used for primary winding shall meet the requirement of latest version of IS: 2705 or IEC-61869 (Part-2). The successful Agency shall in his bid furnish detailed calculations for selection of winding cross-sections. The selected amp-turns for CTs shall be justified on the basis of type test reports.
- (c) It is desired that from the point of view of adequate mechanical strength in the normal course and also during short circuit, proper precaution should be taken. The following arrangement or any equivalent suitable arrangement, which should be described in the bid, shall be provided for this purpose:
 - i. The primary conductor should be held firmly and for this purpose suitable clamping arrangement shall be provided and explained through suitable sketch. Firm clamping arrangement is a must and holding of winding using nylon rope shall not be acceptable.

- ii. The neck of brass tube should be properly fixed to support the primary windings of CT.
- iii. A sturdy arrangement should be provided to secure the bottom of primary winding in place. Also separate arrangement will be necessary to hold the secondary windings in place. The arrangements for primary winding and for secondary cores shall be independent of each other. Any common arrangement is not acceptable.
- iv. At least two clamping should be done on each sides of the primary winding and a minimum number of 4 Nos. nuts and bolts should be provided on each side. The nuts and bolts arrangement used for holding active parts should be suitably dimensioned. The bolts should be tightened with the nuts and also a check nut for proper locking.

2.14 SECONDARY WINDING:

Suitably insulated copper wire of not less than 97% conductivity electrolytic grade shall be used for secondary windings. Enamel, if used for conductor insulation, shall be either polyvinyl acetate type or amide type and shall meet the requirements of latest version of IS: 4800 or equivalent International Standard. The exciting current of the CT shall be as low as possible. The successful Agency shall furnish during detailed engineering, the magnetization curve for all the cores.

2.15 PRIMARY TERMINAL:

For various ratings of CTs, selection of primary terminal only of copper material shall be made carefully. The primary terminal on either side of the tank shall be of proper length preferably not less than 100 mm to accommodate terminal connector. The dia. / size of the primary terminal shall be such that the current rating available is at least 1.5 times the rated current of the CT. It would be obligatory on the part of the successful Agency to specify material, diameter, length and current rating of primary terminal which shall be used for CTs of different ratio. The primary terminal studs to accommodate terminal connector for take-off shall be plain and not threaded. The details may be explained through suitable sketch. The primary terminals shall be of heavily tinned electrolytic copper. The minimum thickness of tinning shall be 15 microns.

2.16 SECONDARY TERMINAL:

Secondary terminal shall be terminated to stud type non disconnecting terminal blocks inside the terminal box. The studs shall be provided with at least three nuts and adequate plain and spring washers for fixing the leads. The studs, nuts and washers shall be of brass, duly nickel-plated. The minimum outside diameter of the studs shall be of proper size preferably not less than 8 mm. The length of at least 15 mm shall be available on the studs for inserting the leads. The horizontal spacing between centres of the adjacent studs shall be at least 1.5 times the outside circum dia. of the nuts. The arrangement should be shown through suitable sketch.

2.17 CORE:

Core lamination shall be of grade M4 Toroidal core or any equivalent / superior grade core material shall be of cold rolled grain oriented high-grade non-ageing electrical silicon laminated steel other equivalent alloys of low hysteresis loss and high permeability to ensure high accuracy at both normal and over currents. The cores used for protection shall produce undistorted secondary current under transient conditions at

all ratios with specified CT parameters. The current transformer core to be used for metering shall be made of mu metal and shall be of accuracy class specified in the Annexure –1. The saturation factor of metering core shall be lower than or equal to 5 not to cause any damage to measuring instruments in the event of maximum short circuit current. The protection core shall be 5P20 core designed for a minimum saturation factor of 20 for the highest setting. The magnetization curves for this core shall be furnished with the bid. As far as PS class core is concerned all precautions shall be taken in design to achieve the knee point voltage without exceeding requirement of excitation current as specified in Annexure-1. Magnetization curve for the same shall be furnished.

2.18 RATIO CHANGING ARRANGEMENT:

Primary current ratio changing arrangement is not accepted.

2.19 SPECIAL REQUIREMENTS FOR CURRENT TRANSFORMERS:

2.19.1 OVERLOADING:

The CTs shall be suitable for continuous overloading up to 120% maximum rated primary current. The following requirements therefore should be noted:-

- a) It should be specifically confirmed that the CTs offered against the specification are suitable for continuous overloading of 20% above rated current. For this purpose, precaution taken in design of equipment may be suitably explained.
- b) For CTs which are to be designed for 20% overloading, the permissible temperature rise of CT winding over the reference ambient temperature of 40°C at 120% rated current, rated frequency and with a unity power factor burden corresponding to the rated output connected to the secondary windings shall be 5 degree less than the permissible value as specified in latest version of IS: 2705 (Part-1).

2.19.2 CONSISTENCY OF ACCURACY:

It should be specifically confirmed that with 20% continuous overloading, the ratio/ phase angle errors of the CTs shall be maintained strictly within specified limits without any drift and variation shall take place due to overloading of Current Transformers. Current transformer's characteristics shall be such as to provide satisfactory performance of burdens ranging from 25% to 100% of rated burden over a range of 1% to 100% of rated current in case of metering CTs and up to the accuracy limit factor/knee point voltage in case of relaying CTs.

3.0 TESTS:

3.1 TYPE TEST:

The equipment offered, shall be fully type tested as per relevant Indian Standards or equivalent International Standard. Copy of type test reports shall be enclosed with the bid. For any change in the design/ type already type tested and the design/ type offered against this bid, the Purchaser reserves the right to demand repetition of same or all type tests without any extra cost.

In the event of order for supply of 220 kV CTs, the supplier has to furnish type test report for the following:

- i. Short time Current Test

- ii. Temperature rise Test
- iii. Lighting impulse Test (under electrically exposed condition)
- iv. High voltage power frequency wet withstand Test
- v. Radio interference voltage measurement
- vi. Ageing Test
- vii. Transient Response Test
- viii. Switching Impulse Withstand Test.
- ix. Seismic withstand test
- x. Thermal stability test, i.e. application of rated voltage and rated extended thermal current simultaneously by synthetic test circuit
- xi. Thermal co-efficient test i.e. measurement of tan delta as a function of temperature (at ambient and between 80°C & 90°C) and voltage (at 0.3, 0.7, 1.0 and 1.1 Um/√3)
- xii. The current transformer shall be subjected to Fast Transient test by any one of the following two methods given below to assess the CT performance in service to withstand the high frequency over voltage generated due to closing & opening operation of isolators. Alternatively, method as per IEC:44-1 may be followed:

Method I: 600 negative polarity lightning impulses chopped on crest will be applied to current transformer. The opposite polarity amplitude must be limited to 50% of crest value when the wave is chopped. One impulse per minute shall be applied and every 50 impulse high frequency currents from the windings and total current to earth will be recorded and be compared with reference currents recorded applying one or more (max 20) reduced chopped impulses of 50% of test value.

Oil samples will be taken before and 3 days after the test. Gas analysis must not show appreciable rate of increase in various gases related with the results of the analysis performed before test.pl

Total sum of crest values of current through secondaries must not exceed 5% of the crest value of total current to earth.

CT must withstand dielectric tests after this test to pass the test.

Method II: 100 negative polarity impulses with a rise and fall time of less than 0.25 microseconds corrected to atmospheric condition shall be applied at one minute interval and total current through insulation of earth will be recorded. The amplitude of first opposite polarity should be limited to 50% of the chopped impulse crest value. Voltage and total current wave shapes shall be recorded after every 10 impulses, and will be compared with reference wave shapes recorded before test at 50% of test values.

Oil sample shall be taken before and 3 days after the test and CT shall be deemed to have passed the test if the increase in gas content before and after test is not appreciable.

3.2 ACCEPTANCE AND ROUTINE TESTS:

The manufacturer shall carry out all acceptance and routine tests as stipulated in the

relevant Indian Standards or equivalent International Standards in presence of TFL/OPTCL representative which are given below:

- i. Verification of terminal markings and Polarity.
- ii. Inter turn Over voltage Test
- iii. Partial discharge test
- iv. Power frequency dry withstand Test on Primary winding.
- v. Power frequency dry withstand Test on Secondary winding.
- vi. Determination of errors according to requirements of appropriate designation or accuracy class.
- vii. Dimension check as per approved drawings.
- viii. Knee Point Voltage Test
- ix. Magnetization Curve Test.

In addition to other acceptance tests 220kV CTs, the following tests shall also be carried out:-

x. Temperature Coefficient Test:

This test will be carried out on minimum one randomly selected 220kV CT of each ratio out of each offered lot of CTs.

Immediately after finalization of the program of type/ acceptance/ routine testing, the manufacturer shall give sufficient advance intimation to the Purchaser, to enable him to depute his representative for witnessing the tests.

During measurement of errors, the resistance of leads connecting the CT under test, the burden box and the standard CT to the measuring bridge should be kept minimum so that accuracy of measurement of CT errors is negligible.

4.0 LIST OF DRAWINGS AND DOCUMENTS:

The successful Agency shall furnish four sets of following details and drawings during detailed engineering;

- a. General outline and assembly drawings of the equipment.
- b. Graphs showing the performance of equipments in regard to magnetization characteristics; ratio & phase angle curves, ratio correction factors curves.
- c. Sectional views showing:
 - i) General Constructional Features.
 - ii) Materials/ Gaskets/ Sealing used.
 - iii) The insulation of the winding arrangements, method of connection of the primary/ secondary winding to the primary/ secondary terminals etc.
 - iv) Porcelain used and its dimensions along with the mechanical and electrical characteristics.
- d. Complete primary terminal assembly which should include the following:
 - i) Complete primary terminal.
 - ii) All sub-assemblies with the help of which the primary terminal shall be brought out from the top tank including washers/ locking arrangements, check nut, main nut etc.
 - iii) Sub-assembly to demonstrate the arrangement of connection of primary winding to primary terminal inside the tank.
 - iv) Terminal connector
- e. Detailed drawing of rupture type pressure relief device with diaphragm, specifying size of diaphragm and its thickness etc.

- f. Name plate.
- g. Schematic drawing.
- h. Type Test reports in case the equipment has already been type tested.
 - i) Test reports, literature, pamphlets of the bought out items and raw material.
- i. Instruction manual to be provided.
- j. Magnetization curves to be provided.

5.0 IMPORTANT REQUIREMENTS FOR ENSURING QUALITY OF MANUFACTURE AND PROCESSING OF EQUIPMENTS:

For processing and vacuum treatment of core/ coil assembly, it is desired that a separate heating chamber and a separate vacuum chamber should have been installed for vacuum treatment of core / coil assembly. Facility should be available to measure quantum of water released during vacuum treatment of core/coil assembly. Make quality and capacity of vacuum chamber along with vacuum level may be brought out.

Completely dust free shop should be available for preparation of winding. This should be confirmed. What is the process employed for wrapping of insulation on primary winding. It is being done manually or through suitable wrapping machine. Various stages of quality checks during manufacture should be highlighted.

6.0 PACKING AND FORWARDING:

Successful Agency/Manufacturer shall ensure that the equipment shall be packed in crates suitable for vertical/ horizontal transport, as the case may be and suitable to withstand handling during transport and outdoor storage during transit.

7.0 DEVIATION FROM TECHNICAL PARTICULARS:

No deviation from technical particulars of equipment and materials will be allowed, which may please be noted.

8.0 FITTINGS AND ACCESSORIES:

Each Current Transformer shall be furnished complete with the accessories listed below:

1. Base frame with anchoring bolts nuts etc. for fixing the equipments on to the structure.
2. Two grounding pads with bolts and spring washers.
3. Lifting Lugs.
4. Clamp type bimetallic terminal connectors.
5. Weather-proof secondary terminal box with set of terminals.
6. Oil level gauge and pressure relief device.
7. Other standard accessories which are not specifically mentioned but are usually provided with current transformers of such type and rating for efficient and trouble free operation

ANNEXURE – 1

PRINCIPAL TECHNICAL PARAMETERS OF METERING CURRENT TRANSFORMER (TFL SS)

S.NO	DESCRIPTION	220kV OUTDOOR METERING CT
1	Type of CT/ Installation	Single phase, Live Tank, oil filled, hermetically sealed, self-cooled, outdoor type
2	Type of mounting	Pedestal Type
3	Suitable for :-	
	a) System Frequency	50 Hz
	b) Rated Voltage (kVrms)	245kV
4	Nominal System Voltage (kVrms)	220kV
5	Ratio and Core Details ***	
	a) Current Ratio	1200-600-300/1-1-1-1-1A
	b) Rated Burden(VA)	Core-3 : 30VA
	c) Class	Core-1 : PS Core-2 : PS Core-3 :0.2S Core-4 : PS Core-5 : PS
	d) Purpose	Metering & Protection
	e) Accuracy Limit Factor	-
	f) Instrument Security Factor	<5
	g) Knee Point Voltage(V)	Core-1 : 1200V at 1200/1 tap Core-2 : 1200V at 1200/1 tap Core-4 : 1200V at 1200/1 tap Core-5 : 1200V at 1200/1 tap
	h) Secondary Winding Resistance, Rct at 75 °C(ohms)	8

	i) Magnetizing Current(mA)	Core-1 : 30/60 Core-2 : 30/60 Core-4 : 30/60 Core-5 : 30/60
6	Method of earthing	Effectively earthed
7	Rated continuous thermal current	120% of rated primary current.
8	Acceptable limit of temperature rise of transformer winding when carrying rated continuous thermal current	Shall be 5 degree less than the values given in the latest version of IS: 2705 or equivalent international standard.
9	Acceptable partial discharge level at 1.1 times the rated voltage	Less than 10 Pico coulombs
10	Radio interference voltage at 1.1 times the rated voltage	Less than 500 micro volts
11	1.2/50 microsecond lightning impulse withstand voltage (kVp)	1050 kVp
12	1 minute dry/wet power frequency withstand voltage primary winding (kV rms)	460 kV rms
13	Power frequency overvoltage withstand requirements for secondary winding (kV rms)	As per IS 2705 (Part-I)
14	Min. Creepage distance of porcelain housing (mm)	7595 mm.
15	Rated short time withstand current with duration (kA rms for seconds)	50kA for 1 sec.
16	Rated dynamic withstand current (kAp)	100
17	Instrument Security Factor	Less Than 5
18	Visual corona extinction voltage (kV)	156 kV
19	Tan Delta at 90° C for Oil (max)	.002
20	Material for Primary Winding	Copper
21	Mounting details (mm)	
*** - SUBJECTED TO TFL/OPTCL APPROVAL		
The Values of Instrument Security Factor, Secondary Winding Resistance & will be finalized after approval of CT sizing Calculation.		

ANNEXURE – 2
GUARANTEED TECHNICAL PARTICULARS

S.NO	DESCRIPTION	220kV OUTDOOR TRANSFORMER
1.	Bidder's name and address	
2.	Name and address of the Manufacturer	
3.	Manufacturer's type designation	
4.	Standards applicable	
5.	Rated frequency (HZ)	
6.	Rated Voltage (kV)	
7.	Rated current (A)	
	a) Rated continuous current (A)	
	b) Rated extended primary current (A)	
8.	Short time thermal current withstand for stipulated time duration (kA)	
9.	Dynamic current withstand (kAp)	
10.	1.2/50 μ s impulse withstand voltage (kVp)	
11.	One minute dry and wet power frequency withstand voltage(kV- rms)	
12.	No. of cores per CT	
13.	Transformation Ratio	
14.	No. of secondary turns	
15.	Rated output at all ratios for metering core (VA)	
16.	Accuracy class	
17.	Secondary winding resistance at different taps for all cores (Ω) (75°C)	
18.	Instrument security factor at different ratios.	
19.	Radio interference voltage at 1.1 Vr/ 31/2 at 1.0 MHZ (Micro volts)	
20.	Whether auxiliary CT provided for metering winding	
21.	Corona extinction voltage (KVrms)	
22.	Partial discharge level (PC)	
23.	Total Creepage distance (mm)	
24.	Type of Primary	
	a) No. of primary turns	
	b) Material and cross-section of primary (mm ²)	
27.	Whether CT is suitable for transportation horizontally.	
28.	Percentage current (ratio) error and phase displacement in minutes at rated burden and	

	at	
	a) 5% rated current	
	b) 10% rated current	
	c) 20% rated current	
	d) 120% rated current	
29.	Percentage current (ratio) error and phase displacement in minutes at 25% rated burden and at	
	a) 5% rated current	
	b) 10% rated current	
	c) 20% rated current	
	d) 120% rated current	
30	Quantity of oil per CT (Litres)	
31	Standard to which oil conforms generally.	
32	Characteristics of oil (prior to filling)	
	a) Breakdown voltage (KV rms)	
	b) Dielectric dissipation constant (tan delta)	
	c) Water content (ppm)	
	d) Gas content	
	e) Interfacial tension at 27 ⁰ C (N/m)	
	f) Specific resistance	
	i) At 90 ⁰ C (Ω cm)	
	ii) At 27 ⁰ C (Ω cm)	
33.	Whether current transformers are hermetically sealed. If so, how?	
34.	Total weight (Kg)	
35.	Transport weight (Kg)	
36.	Temperature rise over an ambient temperature of 40 ⁰ C for continuous operation at rated Continuous thermal current.	
	i) Winding	
	ii) Oil	
	iii) External surface of the core, metallic parts in contact with or adjacent to insulation.	
37.	Whether CT characteristic curves enclosed.	
	a) Ratio and phase angle curve	
	b) Magnetisation curves	
	c) Ratio correction factor curves.	
38.	Data on Primary Winding	
	a) Rated primary current (A)	
	b) No. of conductors in one turn	

	c) No. of turns of primary	
	d) Material of the primary conductors	
	e) Size of the primary conductor (mm x mm)	
	f) Cross-sectional area of each conductor (mm ²)	
	g) Total cross-sectional area of primary winding (mm ²) conductors	
	h) Current density(A/mm ²)	
	i) At highest ratio	
	ii) At intermediate ratio	
	iii) At lowest ratio	
	i) Short circuit current density A/mm ²	
	i) At highest ratio	
	ii) At intermediate ratio	
	iii) At lowest ratio	
	j) Ampere-turn of Primary (AT)	
	i) At highest ratio	
	ii) At intermediate ratio	
	iii) At lowest ratio	
	k) Length of primary conductor (m)	
	l) Weight of primary winding (kg.)	
39.	CORE	
	a) Material and grade of the core	
	b) Thickness of core (mm)	
	c) Net Iron cross-sectional area of core (mm ²)	
	i) Core-1	
	d) Mean magnetic path length (cm)	
	i) Core-1	
	e) Whether B-H curve for the core material, used, furnished? (B-wb/m ² , H- AT/cm)	
	f) Whether specific loss vs. flux density graph for the core material used furnished?	
	g) Axial length of core (mm)	
	i) Core-1	
	h) Inside diameter/outside diameter of the cores (mm)	
	i) Core-1	
	i) Weight of the core (kg)	
	i) Core-1	
40.	SECONDARY WINDINGS	
	a) Rated secondary current (A)	
	b) Material of the secondary windings	
	c) Size of the secondary conductor [Bare/ Insulated] [mm]	

	i) Core-1	
	d) Cross sectional area of the secondary conductor (mm ²)	
	i) Core-1	
	e) Current density of secondary windings (A/mm ²)	
	i) Core-1	
	f) No. of secondary turns	
	i) Core-1	
	g) No. of layers	
	i) Core-1	
	h) No. of turns /layer	
	i) Core-1	
	i) Average length /turn of secondary windings (mm)	
	i) Core-1	
	j) Resistance of the conductor used for secondary winding per meter length at 75 ⁰ C (Ω/M)	
	k) Weight of secondary windings (kg)	
	i) Core-1	
41.	INSULATION	
	a) Name and class of insulating material between core and secondary winding.	
	b) Name/s of Insulating materials between secondary winding and primary windings.	
	c) Insulating materials used to achieve grading of capacitance.	
42.	DIAMETER OF WINDINGS	
	a) Inside / outside diameter of secondary windings (mm)	
	i) Core-1	
	b) Inside / outside diameters of primary winding (mm)	
	c) Minimum clearance from tank (mm)	
	d) Minimum clearance from secondary to tank (mm)	
43.	TANK AND SECONDARY TERMINAL BOX	
	a) Material of the CT tank	
	b) Material of the CT secondary terminal box	
	c) Thickness of CT tank material (mm)	
	d) Thickness of CT secondary terminal box material (mm)	
	e) Zinc coating of the CT tank (gm/m ²)	

	as per relevant upto date ISS	
	f) Zinc coating of the CT secondary terminal box (gm/m ²) as per the relevant upto date ISS.	
	g) Ingress protection rating of the Secondary terminal box.	
	h) Weight of the tank, fittings and other accessories (kg)	
44	INSULATOR	
	a) Manufacturer's name	
	b) Type	
	c) Applicable standards	
	d) Height (mm)	
	e) Diameter (top) (mm)	
	f) Total Creepage distance (mm)	
	g) Rated voltage(KV)	
	h) Power frequency Withstand voltage for 1 min. dry and wet. (KV – rms)	
	i) 1.2/50 micro- sec impulse withstand voltage (KVP)	
	j) Corona extinction voltage (kV)	
	k) Weight (Kg)	
	l) Maximum allowable span (mm)	
	m) Cantilever strength (kg)	
	n) The drawing enclosed	
45	Dielectric dissipation factor at 245/1.732kV (for 220kV C.T) At ambient temperature.	
46	Accuracy class of standard C.T. to be used towards determination of ratio errors and phase angle errors for metering cores.	

PART-7
OUTDOOR 220kV
Metering Potential Transformer

TECHNICAL SPECIFICATION FOR 245 kV VOLTAGE TRANSFORMER

1. SCOPE:

The scope covers design, engineering, manufacturing, assembly and supply of Single phase 220kV voltage transformer for 220/33kV TFL Substation, Angul, Odisha. It is not the intent to specify completely here in all the details of design and construction of equipments. However, equipments shall conform in all respect to the high standard of engineering design and workmanship and shall be capable of performing in continuous commercial operation up to Bidder's guarantee in a manner acceptable to purchaser, who will interpret the meanings of drawings and specifications and shall have the power to reject any work or material which in his judgment, are not in accordance therewith. The offered equipment shall be complete with all components necessary for their effective and trouble free operation. Such components shall be deemed to be within the scope of Bidder irrespective of whether they are superficially brought out in this specification and / or in the commercial order or not.

2. SITE INFORMATION

The 220kV voltage transformer to be supplied against this specification shall be suitable for satisfactory continuous operation under the following Topographical and Meteorological conditions:-

S.NO	PARTICULARS	CONDITION
1.	Maximum ambient air temperature	55 deg C
2.	Minimum ambient air temperature	5 deg C
3.	Average ambient air temperature	32 deg C
4.	Maximum Relative Humidity	100%
5.	Maximum altitude above mean sea level	Below 1000m
6.	Maximum wind speed	50 m/s
7.	Isoceraunic level	70 Days/year
8.	Seismic level	Zone-III

3. STANDARDS:

Bidders may please note that 220kV voltage transformer shall be manufactured, tested and supplied with all guaranteed technical particulars generally conforming to meet the requirement of this technical specification and relevant latest national standards of India or international electro technical commission standards with latest amendments of relevant standards rules and codes.

S No	Indian Standard	Description	International Standard
1.	IS- 3156 (Part IV)	Voltage Transformer	-
2.	-	Instrument Transformer	IEC- 61869-1
3.	-	Instrument transformers – Part 3: Additional	IEC- 61869-3

		requirements for inductive voltage transformers	
4.	-	Instrument Transformer- Measurement of partial discharge	IEC- 60044-4
5.	IS- 335	Insulating oil for transformers and switchgears	-
6.	IS- 2165	Insulation Co-ordination for equipment of 100 kV and above.	-
7.	IS:2071 (Part III)	Method of High Voltage Testing – Measuring devices.	-
8.	-	Insulation co-ordination	IEC-60071
9.	-	High voltage testing techniques	IEC-60060
10.	-	Partial Discharge Measurement	IEC-270
11.	-	Indian Electricity Rules 1956	-
12.	IS:5561	Electrical Power Connector	-
13.	IS:2099	High voltage porcelain Bushings	IEC-60137
14.	IS:4800	Enameled Round Winding Wires	-
15.	IS:2629	Recommended practice for hot dip galvanizing of Iron & Steel	-
16.	IS-2633	Methods of testing hot dipped galvanized articles	-
17.	-	Guide for selection of Insulators in polluted conditions	IEC-815
18.	IS – 8263 – 1976	Method for Radio interference test on high voltage insulator	IEC 56/4 (1975)
19.	OISD - RP - 149	Design aspects for safety in electrical system	
20.	OISD – STD – 173	Fire prevention and protection system for electrical installations	

If the equipment offered by Bidders conforms to any other standards, salient points of comparison between the standards adopted and the specific standards shall be clearly brought out in relevant schedule of technical deviation. It will be sole responsibility of successful Agency to prove that the salient features of offered equipment are equivalent or better than IS.

The bidder shall also note that list of standards presented in this specification is not complete. Wherever necessary the list of standards shall be considered in conjunction with specific IS/IEC.

Metering PT shall be used for metering Purpose of the line to MRSS.

When the specific requirements stipulated in the specifications exceed or differ than those required by the applicable standards, the stipulation of the specification shall take precedence.

The equipment conforming to standards other than specified above shall be subject to M/S TFL/OPTCL approval.

4. AUXILIARY POWER SUPPLY:-

1.	Power Device	220V, 1 phase 2 wire 50 Hz, Solidly earthed AC supply
2.	D.C. Alarm, control and protective device	220V, 2 wire, Unearthed DC supplies

Each of the foregoing supplies will be made available by purchaser at one terminal point for each Voltage Transformer for operation of its accessory and auxiliary equipments. Bidders scope shall include supply of interconnecting cables, terminal boxes etc .The above supply voltage may vary as below and all devices shall be suitable for continuous operation over entire range of voltage.

The above power supplies are subject to the variations given below:-

A.C Supply

Voltage Variation $\pm 10\%$

Frequency Variation $\pm 4\%$

D.C Supply

Voltage variation – 20% to + 10%

5. DEVIATION FROM TECHNICAL PARTICULARS:

No deviation from technical particulars of equipments and materials will be allowed, which may please be noted

6. GENERAL REQUIREMENTS FOR 220kV VOLTAGE TRANSFORMERS

BASIC DESIGN:

The 220kV voltage transformers shall be of outdoor type, oil immersed, hermetically sealed, self-cooled suitable for operation in 3 phases, and 220kV solidly grounded system under the climatic conditions specified. These VTs should be mechanically strong to withstand the stresses due to wind speed 50 m/s Zone-3. The outer shell is wet processed porcelain with liberal creepage distance to prevent flashover under the most adverse tropical conditions.

The voltage transformers shall have a secondary winding which is meant for line for line metering purpose. The secondary shall be rated for $110/\sqrt{3}$ V. The 220kV voltage transformers shall have the technical particulars as listed below. Particulars which are subject to guarantee shall be furnished along with the bid. Any other particulars considered essential may please also be furnished in the guaranteed technical particulars.

TABLE 1.0

S.N	Description	METERING VT
1.	Type of VT	Single phase, oil filled, hermetically sealed, outdoor type.
2.	Type of mounting	Pedestal Type
3.	Nominal system voltage	220kV

4.	Highest system voltage	245 kV
5.	System frequency	50 Hz
6.	Earthing	Solidly earthed.
7.	No. of secondary windings	One
8.	Application	Metering
9.	Voltage ratio for the secondary winding	$110/\sqrt{3}$ V
10.	Class of accuracy	0.2
11.	Rated output burden VA	50 VA
12.	Rated short time rating	50kA for 1 sec.
13.	Voltage Factor Fv	i) 1.2 for Continuous ii) 1.5 for 30 Seconds
14.	Maximum temperature rise over an ambient temperature of 40°C	Within the limits as per IEC: 60044 Part- 5
15.	Creepage distance	31mm/ kV/ 7595mm
16.	Acceptable partial discharge level at Um voltage	10 pC
17.	Radio interference voltage at $1.1 U_m/\sqrt{3}$ voltage	Less than 500 micro volts
18.	Visual corona extinction voltage (kV rms)	156 kV rms
19.	1.2/50 microsecond lightning impulse withstand voltage (kVp)	1050 kVp
22	1 minute dry/wet power frequency withstand voltage primary winding (kV rms)	460 kV rms
23	1 minute Power frequency test voltage i Between LV (HF) terminal and earth ii Secondary winding (kV rms)	i 10kV rms ii 3 kV rms
24	Mounting Details	To be provided.
25	Terminal Connector	
a	Type	Suitable for ACSR conductor*
b	Quantity	-
c	Arrangement for conductor take off	As per layout

26	Oil Characteristics :	
a	Breakdown voltage	As per IS:335
b	Dielectric dissipation constant at 90 ° C	.002
c	Water content	i) New untreated oil – 50 ppm. ii) After treatment – 15 ppm.
d	Minimum Interfacial tension at 27 deg C (N/m)	0.04 N/m
e	Specific resistance (resistivity)	
	i. at 90 ° C	35×10^{12} ohm-cm.
	ii. at 27 ° C	1500×10^{12} ohm-cm

*- to be confirmed by TFL/OPTCL

The insulation of the instrument transformer shall be so designed that the internal insulation shall have higher electrical withstand capability than the external insulation. The designed dielectric withstands values of external and internal insulations shall be clearly brought out in the guaranteed technical particulars. The dielectric withstand values specified are meant for fully assembled instrument transformers.

TECHNICAL REQUIREMENT:

- (i) Each VT shall be suitable for connection directly to the line without the use of auxiliaries such as isolating switches or fuses. The capacitors of the unit shall be so designed that the application of impulse voltage shall not damage the internal working elements or cause a change in their electrostatic capacitance.
- (ii) The VT shall incorporate potential devices, suitable for connection to equipment comprising of synchroscope, voltmeter, synchronising lamps and the automatic synchroniser.
- (iii) An oil level indicator and a pressure relief device capable of releasing abnormal internal pressure may be provided.
- (iv) Temperature rise: - Maximum temperature attained by any part of the equipment when in service at site under full load conditions, shall not exceed limits specified as per IEC. The temperature rise at the 1.2 times the rated primary voltage when applied continuously at the rated frequency and rated burden shall not exceed the limit specified in IEC and the temperature rise at 1.5 times the rated primary voltage when applied for 30seconds starting from the previous stable operating conditions at rated frequency and rated burden, shall not exceed the above temperature limit by more than 10°C.

DAMPING DEVICE:

Each voltage transformer shall be provided with suitable damping device so that Ferro resonance oscillations due to saturation of iron core of transformer or of any inductance connected in parallel with it or initiated by any other condition shall disappear immediately and shall not affect the proper working of secondary meters. The design of the compensating reactor and the intermediate transformer as well as of the additional damping devices inserted

in the secondary of intermediate transformer shall be such that the phenomenon of Ferro resonance shall not sustain for more than 2 seconds as per Clause 6.1.2 of IS:3156 Part-4.

PORCELAIN HOUSING:

- i. The VT should be designed using single porcelain housing. No joints shall be provided in the porcelain. The housing shall be made of homogeneous, vitreous porcelain of high mechanical and electrical strength. Glazing of porcelain shall be of uniform brown or dark brown colour with a smooth surface arranged to shed away rain water or condensed water particles (fog). The profile of porcelain shall be aerodynamic type as per latest version of IEC-815.
- ii. Details of attachment of metallic flanges to the porcelain shall be brought out in the Bid.

BASE HOUSING:

The secondary unit comprising of compensating reactor, intermediate transformer along with its accessories, damping impedances etc, shall be contained in a steel enclosure, hot dip galvanized as per latest IS:2629. The steel enclosure will also serve as a mounting base for the capacitor stack.

The secondary terminals of the potential device and the terminal for high frequency coupling as well as the earthing terminal shall be placed inside a water proof terminal cabinet outside the steel enclosure. This cabinet shall have IP 55 protection with hot dip galvanised and shall have hinged door provided with locking arrangements.

MOUNTING:

The VT shall be suitable for mounting on steel structure. The mounting dimensions of base plate shall match with the mounting dimensions of structure which will be provided later after finalizing the structure.

INSULATION OIL:

The insulating oil for first filling of oil in each VT shall be in the scope of bidder. Only best quality new EHV Grade transformer oil should be used with the equipments shall be as per IS: 335. The BDV of oil will have to be recorded in the test certificate. The oil shall comply in all respect with the provisions of the latest version of IS: 335.

SL. NO	Characteristics	Requirements
1.	Appearance	The oil shall be clear and transparent and free from suspended matter or sediments.
2.	Density at 29.5 deg. C max.	0.89 g/cm ³ .
3.	Kinematic viscosity at 27 deg C. max.	27 CST
4.	Interfacial tension at 27 deg. C. min.	0.04 N/m

5.	Flashpoint(Min.)	140 deg. C
6.	Pour point max.	-6 deg. C.
7.	a) Neutralisation value (Total acidity)	0.03 mg KOH/g.
	b) Inorganic acidity / alkalinity	Nil
8.	Corrosive Sulphur (in terms of classification of copper strip)	Non- corrosive.
9.	Electric strength (break-down voltage) Min.	
	a)New unfiltered oil	30 kV (rms)
	b)After filtration	60 kV (rms), (if the above value is not attained, the oil shall be filtered).
10.	Dielectric dissipation factor (tan delta) at 90 deg. C max.	0.002
11.	Specific resistance (resistivity)	
	a)90 deg. C. min.	35*(10) ¹² ohm- cm.
	b) at 27 deg. C. min.	1500 * (10) ¹² ohm- cm.
12.	Oxidation stability	
	a) Neutralization value after oxidation. Max.	0.40 mg/ KOH/g.
	b) Total sludge, after oxidation max.	0.10 percentage by weight.
13.	Presence of oxidation inhibitors.	The oil shall not contain antioxidant inhibitors.
14.	Water content, max.	i) New untreated oil – 50 ppm. ii) After treatment – 15 ppm.
15.	Aging characteristics after accelerated ageing (open breaker method with copper catalyst)	
	a)Resistivity	
	i)At 27 deg. C min.	2.5 * (10) ¹² ohm cm.
	ii)At 29 deg. C min.	0.2 * (10) ¹² ohm cm.
	b) Tan delta at 90 deg. C. max.	0.2(max.)

	c) Total acidity	0.05 mg. / KOH/g (max.).
	d) Sludge content percent by weight	0.05(max.).

The instrument transformer shall be vacuum filled with oil after processing and thereafter hermetically sealed to eliminate breathing and to prevent air and moisture from entering the tanks. Oil sampling valve provided at the bottom of VT should be protected by providing metallic cover or blanking plug/ plate. Valve should be welded to avoid any leakage. Nitrogen filling valve should be fitted with an indicator or cap to prevent leakage of nitrogen. The method adopted for hermetic sealing shall be described in the bid.

RATING PLATE:

The VT shall be provided with a rating plate with dimensions and markings as per latest version of IS: 3156/ IEC-60044 (Part-5). The markings shall be punched/ engraved and not painted. This rating plate shall also contain our purchase order no. and date.

EARTHING:

- i. Metal tank of instrument transformer shall be provided with two separate Earthing terminals for bolted connection to Earth flat to be provided by the purchaser for connection to station earth mat.
- ii. Instrument transformer shall be provided with suitable lifting arrangement to lift the entire unit. Lifting arrangement shall be positioned in such a way as to avoid any damage to the porcelain housing or the tank during lifting for installation/transport. Necessary string guides, if required shall be offered which shall be removable type.

SECONDARY TERMINAL BOX:-

- i. All secondary terminals of the VT shall be brought out in a weather proof terminals box provided at one side of each voltage transformer for easy access.
- ii. The terminal box shall be hot dip galvanised.
- iii. The terminal box shall be provided with a removable cable gland plate at the bottom for mounting three cable glands suitable for 1100V grade, steel wire armoured, PVC insulated. PVC sheathed suitable standard copper conductor control cables. The cables glands shall be included within the scope of supply and shall be screw on type and made of brass.
- iv. The terminal box shall be provided with a door on the front so as to permit easy access to secondary terminals. The door shall be provided with locking arrangement and shall be suitable arrangement to prevent penetration of moisture and water into the terminal box
- v. The terminal box shall be provided with a terminal board. The Terminal shall be so staggered that connection of external cable to any terminal shall be so staggered that connection of external cable to any terminal block should be possible without disturbing the rest of the connections. The terminal block should be such as to provide maximum accessibility to all conductor terminals.
- vi. The terminal block shall be fully enclosed with removable cover made of moulded, non-inflammable, plastic material with boxes.

- vii. The terminal block arrangements shall be such that it will be possible to connect or disconnect terminals on live circuits.
- viii. All terminals shall be clearly marked with identification number to facilitate connection to external box.

CABLES TERMINATION:-

Conveniently located suitable glands for terminating multicore PVC control cable and cable box for the necessary fasteners for installing the cable glands and cable boxes shall be provided.

SECONDARY FUSES:-

Fuses of adequate capacity shall be provided in each secondary circuit in the secondary terminal box. The selection of fuses shall be done very carefully so as to protect the VT efficiently. The rating, type and make of fuses provided shall be indicated in the tender. Each of the secondary winding shall be provided with duplicate fuses in the line (Phase) terminals. Other terminals will be provided with links.

EXTERNAL INSULATION:-

- a) The external insulation shall comprise of hollow single piece porcelain insulator which shall also serves as a housing or the main insulation and other internal parts of the VT, Insulators shall be of high grade and homogeneous porcelain made by the wet process. The porcelain shall have glazing of uniform brown colour and shall comply with requirement of IS: 5621 – 1970 in all respects. The Skirt forms shall be carefully selected to achieve the necessary flashover distance and total / protected creep age distance as specified in Table 1.0.
- b) All current carrying contact surfaces shall be tipped with silver plating and the silver plating shall not be less than one millimetre in thickness.
- c) The porcelain housing shall have ample insulation, mechanical strength and rigidity for the condition under which they will be used at site and shall be designed to prevent accumulation of explosive gases and provide adequate oil circulation to remove internal heat.
- d) There shall be no undue stressing of any part of the bushing due to temperature change and adequate means shall be provided to accommodate conductor expansion.
- e) All metal parts shall be of high strength and hot dip galvanised as per IS 2633 (amended upto date). All current carrying parts shall be non-ferrous or alloys and shall be designed to eliminate sharp points, edges and sharp faces.
- f) The porcelain housing shall be unaffected by atmospheric condition e.g. weather, fumes, zone, acids, alkalis, dust and rapid changes of air temperature. The stresses due to expansion and contraction in any part of the VT shall not load to development of defects in the porcelain housing. The porcelain housing shall have factor of safety against earthquake and other loads.
- g) Fixing material / cement shall not enter into chemical action with the metal parts or cause fracture by expansion in service. Cement thickness shall be as small as possible and

proper care shall be taken to centre and locate individual parts correctly during cementing.

- h) Each porcelain housing shall having marked upon it the manufacturer's name and such other marks as may be required to assist in the selection of representative batches for the purpose of sample testing.
- i) Porcelain shall not engage directly with hard metal and where necessary, gasket shall be interposed between porcelain and the fittings. All porcelain clamping surface in contact with gasket shall be accurately ground and shall be free of glaze.
- j) Porcelain housing insulators shall be designed to facilitate natural cooling.
- k) Each porcelain housing shall be provided with:-
 - i) Oil level gauge visible from ground level and
 - ii) Convenient means for sampling and drainage of oil from bottom.
- l) The porcelain shall be so designed that when operating at highest system voltage specified, there will be no electric discharge between the conductors and porcelain which could cause corrosion or injury to conductors, insulators or supports by formation of substances produced by chemical action.
- m) The insulation of the porcelain shall be co-ordinated with that of the voltage transformers such that the flash over, if over, if any, will occur external to the voltage transformer.

PAINTING & FINISH:

All interiors tanks and other metal parts shall be thoroughly cleaned to remove all rust, scales, erosion, grease or other adhering foreign matter. All steel surfaces in contact with insulating oil as far as accessible shall be painted with not less than two coats of heat resistant, oil insoluble, insulating varnish. All metal parts not accessible for painting shall be made of corrosion resisting material. All machine finished or bright surfaces shall be coated with a suitable preventive compound and suitably wrapped, or otherwise protected. All paints shall be carefully selected to withstand tropical heat and extremes of weather. The paint shall not scale off or crinkle or be removed by abrasion due to normal handling. Bolts and nuts exposed to the atmosphere shall be of galvanized steel.

7. TESTS:

TYPE TEST:

The equipment offered, shall be fully type tested as per relevant Indian Standards or equivalent International Standard. Copy of type test reports shall be enclosed with the bid. For any change in the design/ type already type tested and the design/ type offered against this bid, the Purchaser reserves the right to demand repetition of same or all type tests without any extra cost.

In the event of order for supply of 220 kV VTs, the supplier has to furnish type test reports of the following for approval:

- i. Temperature rise Test.
- ii. Capacitance and $\tan \delta$ measurement at power-frequency.
- iii. Short-circuit withstand capability test.

- iv. Impulse Test.
- v. Wet test for outdoor capacitor voltage transformer
- vi. Tightness test of a liquid-filled electromagnetic unit.
- vii. Ferro-resonance tests.
- viii. Accuracy tests.
- ix. Transient response test.
- x. Radio interference voltage measurement.

ROUTINE AND ACCEPTANCE TEST:

The manufacturer shall carry out all acceptance and routine tests as stipulated in the relevant Indian Standards or equivalent International Standards in presence of Purchaser's representative. The VTs shall be subject to the following routine/site tests in addition to routine tests as per IEC/IS.

- i. Verification of terminal making and polarity test
- ii. Power-frequency withstand test and measurement of capacitance, $\tan\delta$
- iii. Partial discharge
- iv. Verification of terminal markings
- v. Power-frequency withstand tests on the electromagnetic unit
- vi. Ferro-resonance check
- vii. Accuracy check

8. INSPECTION:

- i. The Purchaser shall have access at all times to the works and all other places of manufacture, where the 220 KV Capacitor Voltage Transformer are being manufactured and the successful Agency shall provide all facilities for unrestricted inspection of the Manufacturer's works, raw materials, manufacture of all the accessories and for conducting necessary tests as detailed herein. Purchaser reserves the right to insist for witnessing the acceptance/routine testing of the bought out items. Supplier shall submit the routine test certificates of bought out items and raw material, at the time of routine testing of the fully assembled VT.
- ii. The successful Agency shall keep the Purchaser informed in advance of the time of starting and of the progress of manufacture of equipment of the various stages, so that arrangements could be made for inspection.
- iii. No material shall be dispatched from its point of manufacture unless the material has been satisfactorily inspected and tested. Successful Agency shall within 30 days of placement of order, submit list of bought out accessories and the names of sub-suppliers.
- iv. The acceptance of any quantity of the equipment shall in no way relieve the successful Agency of his responsibility for meeting all the requirements of this specification and shall not prevent subsequent rejection if such equipment is later found to be defective.

- v. In case for any reasons inspection is not completed or equipment is not found to be complete with all accessories as per confirmation given with the letter of inspection call, purchaser will reserve the right to recover the complete cost of deputation of inspecting team to the works of the manufacturer.

9. QUALITY ASSURANCE PLAN:

The Manufacturer / successful Agency must establish that they are following a proper quality assurance programme for manufacture of 220 kV VT. The successful Agency shall invariably furnish following information along with his offer. Information shall be separately given for individual type of equipment offered.

- i. Statement giving list of important raw materials, names of sub supplier for the raw material, list of standards according to which the raw material are tested, list of tests normally carried out on raw material in presence of successful Agency/Manufacturer's representative and copies of test certificates.
- ii. Information and copies of test certificates as mentioned in (i) above in respect of bought out items.
- iii. List of manufacturing facilities available.
- iv. Levels of automation achieved and list of areas where manual processing exists.
- v. List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspection.
- vi. Special features provided in the equipment to make it maintenance free.
- vii. List of testing equipment available with the Bidder for final testing of equipment specified and test plant limitations, if any, vis-à-vis type tests, acceptance and routine tests specified in the relevant Indian Standards or equivalent international standard. These limitations shall be very clearly brought out in schedule of deviations from specified test equipments.

The successful Agency shall submit following information to the Purchaser.

- i) List of raw materials as well as bought out accessories and the names of sub supplier selected from the lists furnished along with offer.
- ii) Type test certificate of the raw material and bought out accessories.
- iii) Quality Assurance Plan (QAP) with hold points by Purchaser's inspection. The quality assurance plans and hold points shall be discussed between the Purchaser and successful Agency before the QAP is finalized.

The successful Agency shall submit the routine test certificates of bought out items and for raw material at the time of routine testing of the fully assembled equipment.

10. LIST OF DRAWINGS AND DOCUMENTS:

The successful Agency shall furnish four sets of following drawings during detailed engineering;

- a) General outline and assembly drawings of the equipment showing front & side elevation and plan views and all accessories, external features with detailed dimensions, net & shipping weights, size of lifting lugs, quantity of insulating oil .
- b) Sectional views showing General Constructional Features, lifting lugs, etc.
- c) Name plate drawing with terminal markings & connection diagram.
- d) Schematic drawing.
- e) Dimensional drawing of terminal clamps and connectors showing material composition, permissible temperature rise, current carrying capability etc.
- f) Type Test reports
- g) Test reports, literature, pamphlets of the bought out items.

The successful Agency shall within two weeks from signing of contract, submit four sets of all the above drawings for Purchaser's approval. The Purchaser shall communicate his comments/approval on the drawings to the successful Agency within reasonable time. The successful Agency shall, if necessary, modify the drawings and resubmit four copies of the modified drawings for Purchaser's approval within two weeks from the date of Purchaser's comments. After receipt of Purchaser's approval, the successful Agency shall within three weeks submit 2 prints and two good quality reproducible (Soft copy) of the approved drawings for Purchaser's use.

The manufacturing of the equipment shall be strictly in accordance with the approved drawings and no deviation shall be permitted without the written approval of the Purchaser. All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawing shall be at the successful Agency's risk.

The successful Agency shall submit neatly printed and bound two volumes of operation, maintenance and erection manuals in English Language, for each type and rating of equipment supplied for distribution, along with the equipments. The manual shall contain all the drawings and information required for erection, operation and maintenance of the equipments. The manual shall also contain a set of all the approved drawings and type test reports etc.

Approval of drawings by Purchaser shall not relieve the successful Agency of his responsibility and liability for ensuring correctness and correct interpretation of the latest revision of applicable standards, rules and codes of practices. The equipment shall conform in all respects to high standards of engineering, design, workmanship and latest revisions of relevant standards at the time of ordering and Purchaser shall have the power to reject any work or material, which in his judgment is not in full accordance therewith.

11. ENGRAVING, PACKING AND FORWARDING:

The details such as order no. and date, year of manufacture should be engraved equipment. The equipment shall be packed in crates suitable for vertical/horizontal transport, as the case may be and suitable to withstand handling during transport and outdoor storage during transit. The successful Agency shall be responsible for any damage during transit, due to improper and inadequate packing and handling. The easily damageable material shall be carefully packed and marked with the appropriate caution symbols. Wherever necessary, proper arrangement for lifting, such as lifting hooks etc., shall be provided. successful Agency shall supply, any material, found short inside the packing cases without any extra cost.

Each consignment shall be accompanied by a detailed packing list containing the following information:

- a) Name of the consignee.
- b) Details of consignment.
- c) Destination
- d) Total weight of consignment.
- e) Handling and unpacking instructions.
- f) Bill of material indicating contents of each package.

The successful Agency shall ensure that the packing list and bill of material is approved by Purchaser before dispatch.

12. COMPLETENESS OF EQUIPMENT AND BOUGHT OUT ITEMS:

Bid shall be complete in all respects and shall include all minor component, accessories, small wiring etc., not specifically mentioned in the Schedule, specifications etc., but essential for the completeness of the system. Bidders shall not be eligible for extra charges in respect of such minor components, accessories, small wiring etc., though not included specifically in this specification but requires for satisfactory operation of equipment offered.

Successful Agency must furnish following information during detailed engineering;

- i. Complete details of all the accessories which will be supplied.
- ii. It is obligatory on the part of successful Agency to ensure that supply of all accessories along with Main equipment is simultaneously delivered to avoid any holdups. Responsibility for obtaining timely supplies of bought out items will rest on the successful Agency and only on this basis, delivery period will be offered in the Bid.
- iii. It may be noted that in case of damages/shortages due to improper packing or any other negligence, replenishment shall be arranged within one month's time. For bought out items, responsibility for guarantee and obtaining immediate replacement in case any defects are noticed and also in case defective supply of any item is reported, will rest on the successful Agency.

ANNEXURE

GUARANTEED TECHNICAL PARTICULARS FOR VT

S.No	DESCRIPTION	220 kV VT
1	General	
a.	Name of manufacturer	
b.	Type	
c.	Standard Applicable	
d.	Type of Installation	
e.	Nominal system voltage (kV)	
f.	Highest system voltage (kV)	
g.	System frequency (Hz)	
h.	Number of secondary's (Nos.)	
i.	Voltage ratio of VT	
j.	Short time rating (kA/s)	
2	Guaranteed Ratings.	
a.	Rated burden of each secondary (VA)	
b.	Accuracy class	
c.	Total simultaneous burden/accuracy class (VA)	
d.	Rated voltage factor:-	
	i. Continuous	
	ii. 30 seconds	
e.	Self-tuning frequency of VT (kHz)	
f.	Temperature rise over ambient temp at 40 ° C	
g.	One minute power frequency test voltage of secondary winding (kV rms)	
h.	One minute power frequency test voltage of HF terminal (kV rms)	
i.	One minute power frequency test voltage (dry & wet) (kV rms)	
j.	1.2/50 micro impulse withstand test voltage (kVp)	
k.	Corona extinction voltage (Minimum) (kV rms)	
l.	Max. Radio interference voltage at $1.1U_r / 1.732$ (μV)	
m.	Total creepage distance (mm)	
n.	Seismic Acceleration (g)	

o.	Partial Discharge (pC)	
p.	System neutral Earthing	
q.	Cantilever strength (kg)	
3.	Construction details	
a.	Overall dimensions	
	i. Overall height	
	ii. Height up to top of terminal pad from mounting plane	
	iii. Diameter and length of terminal pad	
	iv. Material of terminal pad	
	v. Mounting dimensions and diameter of mounting holes	
	vi. Diameter of insulator	
b.	Total weight	
c.	Quantity of oil	
d.	Whether VTs are hermetically sealed if so how.	
e.	Details of dielectric of oil	
f.	Standard to which oil conforms generally	
4.	Characteristics of oil (prior to filling)	
	i. Breakdown voltage (kV)	
	ii. Dielectric dissipation constant (kV)	
	iii. Water content (ppm)	
	iv. Gas content (ppm)	
	v. Interfacial tension at 27 deg C (N/m)	
	vi. Specific resistance (ohm-cm)	
	a. at 90 ° C	
	b. at 27 ° C	
5.	Min. spacing from nearby earthed objects (mm)	
6.	Literature	
a.	Type test reports Standard	
b.	OGA drawing of VT & terminal connector	
c.	Characteristic curves	
d.	Drawing showing clearance from earthed object	
e.	Details of surge arrestor connected at secondary windings of VT	

7.	Temperature rise over an ambient temperature of 40°C	
a.	With 1.2 times rated primary voltage at rated frequency and at rated burdens. i. Winding (°C) ii. Oil (°C) iii. Other Parts (°C)	
b.	With 1.5 times rated primary voltage for 30 seconds at rated frequency and at rated burdens	
8.	Whether VT's suitable for horizontal position	
9.	Percentage Voltage ratio (error)/ phase displacement (min) at 100% rated burden at 0.8P.F lagging for measuring winding a) 80% of rated voltage at rated frequency. b) 120% of rated voltage at rated frequency. c) Accuracy of standard PT to be used during determination of errors (0.05 or better)	
10.	Percentage voltage ratio (error)/ Phase displacement (min) at 25% rated burden at 0.8PF lagging for measuring winding. a) 80% of rated voltage at rated frequency. b) 120% of rated voltage at rated frequency.	
11.	Percentage Voltage ratio error)/ phase displacement (min) at 100% rated burden at 0.8P.F lagging for protection winding a) 2% of rated voltage b) 5% of rated voltage c) 1.2 times of rated voltage d) 1.5 times of rated voltage	
12.	Percentage Voltage ratio (error)/ phase displacement (min) at 25% rated burden at 0.8P.F lagging for protection winding	

	<ul style="list-style-type: none"> a) 2% of rated voltage b) 5% of rated voltage c) 1.2 times of rated voltage d) 1.5 times of rated voltage 	
13.	Capacitance (pF)/ Tan delta between:- <ul style="list-style-type: none"> a) HV-HF point b) HF point-Ground point of Intermediate Transformer. c) HV point-Ground point of Intermediate Transformer. 	
14.	Total Inductive reactance, offered by VT.	

PART-8
OUTDOOR 220kV DISCONNECTOR

TECHNICAL SPECIFICATION OF 220kV OUTDOOR ISOLATOR:

1.0 GENERAL REQUIREMENTS:

The scope covers design, engineering, manufacturing, assembly and supply of Single/Three phase 220kV isolator for 220/33kV TFL SS Angul, Odisha.

The design and workmanship of the 245kV Isolators covered under this specification shall be in accordance with the best Engineering practices to ensure satisfactory performance and service life of 40 years and above.

Unless brought out clearly, the tender shall be deemed to confirm to this specification. Any deviations between this specifications and bid offered, if not clearly brought out and accepted by TFL/OPTCL will not be considered as a valid deviation.

The Vendor shall bring out clearly any additional feature which they deem fit to include to give a complete and comprehensive offer. The vendor shall, however, sustain his reasons for offering such additional features/items in his proposal.

SCOPE:

This specification covers design, engineering, manufacture, assembly, routine testing, inspection and testing before supply, packing, forwarding and delivery erection, testing and commissioning at site of 245kV, 3phase, Motor operated Horizontal **Double break Isolators** along with all the accessories, auxiliary equipment, mandatory spares and maintenance equipment herein required for their satisfactory operation in 220kV Substation at Angul, for **M/s Talcher Fertilizer Limited** herein after referred to as "Purchaser".

SITE INFORMATION:

The Isolators to be supplied against this specification shall be suitable for satisfactory continuous operation under the following topographical and meteorological conditions:-

S.NO	PARTICULARS	CONDITION
1.	Maximum ambient air temperature	55 deg C
2.	Minimum ambient air temperature	5 deg C
3.	Average ambient air temperature	32 deg C
4.	Maximum altitude above mean sea level (m)	Below 1000m
5.	Maximum wind Speed	50 m/s
6.	Isokeraunic level	70 days/year
7.	Degree of Pollution	Heavy

2.0 CODES AND STANDARDS:

The Isolators covered by this specification shall comply with the requirements of the latest edition of

STANDARD	TITLE
IS :9921Part (1-5)	Specification for alternating current disconnecter (Isolators) and Earthing switches for voltages above 1000V.
IEC62270-102	Alternating current disconnectors and Earthing switches
IS:2544	Specification for porcelain post insulators for systems with nominal voltages greater than 1000 volts
IS:2629	Recommended practice for Hot dip galvanizing of iron and

STANDARD	TITLE
	steel.
IS:4759	Hot dip zinc coating on structural steel and other allied products
IS:2633	Method of testing weight thickness and uniformity of coating on fasteners
IS:1573	Electroplated coating of zinc on iron and steel
IS:2016	Plain washers
IS:2165	Insulation Co-ordination
IS:2544	Specification for porcelain post insulators for systems with nominal voltages greater than 1000 volts
IS:5350	Dimensions of indoor and outdoor porcelain post insulators and post insulator units for systems with nominal voltages greater than 1000 V – Part 2
IS:2147	Degree of protection provided by enclosures for low voltage switchgear and control gear
IEC62271-Part 1	Common specification for High voltage switchgear and control gear
IEC60168	Tests on indoor and outdoor post insulators of ceramic material or glass for systems with nominal voltages greater than 1000volts
IEC60273	Characteristic of indoor and outdoor post insulators for systems with nominal voltages greater than 1000volts
	Indian Electricity Rules, 1956
OISD - RP - 149	Design aspects for safety in electrical system
OISD – STD – 173	Fire prevention and protection system for electrical installations

Equipment and material conforming to other internationally recognized standards which ensures equal or better performance than as per the Indian standards shall also be acceptable. In that case, the salient points of difference between the standard adopted and those prescribed in this specification shall be brought out separately in additional information schedule.

3.0 PRINCIPLE PARAMETERS:

1	Type of Isolator	Horizontal Double break motor operated mechanism for Main switch and manually operating mechanism for Earth switch
2	Method of mounting	Upright mounting movement of the blade in a horizontal plane suitable for outdoor installation.
3	Rated Voltage, kV rms	245

4	Rated frequency, Hz	50
5	Rated Nominal current (A)	3150
6	System neutral Earthing	Effectively earthed
7	Number of phases (poles)	3
8	Temperature rise	As per IS 9921 Part 2
9	Safe duration of overload	
	a) 150% of rated current	5 minutes
	b) 120% of rated current	30 minutes
10	Service condition	As per site information mentioned in this specification
11	Rated Short time withstand current	50kA for 1 sec
12	Rated short circuit making current, kA, peak(Both for Isolator and Earth Switch	100
13	Rated duration of short circuit, (second)	1
14	Min. corona extinction voltage (kV rms)	156
15	Max. radio interference voltage (micro volts)at 1.1 times maximum phase	<1000
16	Rated short duration power frequency withstand voltage:- a) Common value kV (rms). b) Across the Isolating distance kV (rms).	460 530
17	1.2/50 μ s lightning impulse withstand voltage, kV (Peak)	
	a) To earth	1050
	b) Across isolating distance	1200
18	Operating time of the Isolator	Shall not exceed 10 seconds
19	Minimum creepage distance (mm)	7595
20	Rated mechanical terminal load a) Straight load (N) b) Across load (N)	800 270
21	Operating mechanism	Motor operated for main switch. Manually operated for earth switch
22	Phase to phase spacing for Installation (mm)	3650
23	Disconnecter Class	M2
24	Earth switch class	E1
25	Operating time of isolator	12 seconds or less

26	Mechanical Terminal Loads (Static as well as Dynamic)	as per IEC
	i) Rating of auxiliary contacts	10 Amps. at 220V DC.
	ii) Breaking Capacity.	2 Amps. DC with time constraint of less than 20ms.

4.0 DUTY REQUIREMENTS

- 4.1 The isolator shall have mechanical endurance of 10000 operating cycles – class M2 and earth switch shall be E1. The Principal parameters for the Isolators shall be as per clause 3.0
- 4.2 Isolators and earth switches shall be capable of withstanding the dynamic and thermal effects of the maximum possible short circuit current of the systems in their closed position. They shall be constructed such that they do not open under influence of short circuit current.
- 4.3 The earth switches, wherever provided, shall have constructional interlock so that the earth switch can be operated only when the isolator is open and not vice-versa. The constructional interlocks shall be built-in construction of isolator and shall be in addition to the electrical and mechanical interlocks provided in the operating mechanism.
- 4.4 In addition to the constructional interlock, isolator and earth switches shall have provision to prevent their electrical and manual operation unless the associated and other interlocking conditions are met. All these interlocks shall be of failsafe type.
- 4.5 Suitable individual interlocking coil arrangements shall be provided. The interlocking coil shall be suitable for continuous operation from DC supply and within a variation range stipulated in this specification.
- 4.6 The isolator shall be capable of making/breaking normal currents when no voltage occurs across the terminals of each pole of isolator on account of make/break operation.
- 4.7 The isolator shall be capable of making/ breaking magnetizing current of 0.7 A at 0.15 power factor and capacitive current of 0.7 A at 0.15 power factor.
- 4.8 Isolator and earth switches shall be able to bear on the terminals the total forces including wind loading and electro dynamic forces on the attached conductor without impairing reliability or current carrying capacity.
- 4.9 In fully open condition of the isolators cum earth switches, the break shall be distinct and clearly visible from ground level.

4.10 Auxiliary Power Supply:

Auxiliary electrical equipment shall be suitable for operation on the following supply system

- | | | |
|---------------------|---|--------------------------------------|
| a) Power Devices | - | 415 Volts, 3 phases |
| (Like drive motors) | | 4 wire, 50 Hz, neutral grounded A.C. |

- | | | |
|--|---|--------------------------------------|
| | | supply |
| b) D.C. Alarm, control
And Protective devices | - | 220V DC, ungrounded 2 wire
supply |
| c) Lighting | - | 240V, Single phase, 50 Hz A.C supply |

4.11 Each of the forgoing supplies shall be made available by the purchaser at the terminal point for each Isolator for operation of accessories and auxiliary equipment. The above supply voltage may vary as below and all devices shall be suitable for continuous operation over the entire range of voltages.

- | | | |
|-------------|---|-----------------------------------|
| A.C. Supply | - | Voltage + 10%; Frequency \pm 4% |
| D.C Supply | - | -10% to 10 % |

5.0 GENERAL TECHNICAL REQUIREMENTS FOR ISOLATOR WITH EARTH SWITCH:

5.1 TYPE & RATING:

The Three phase Double break Isolators shall have three posts per phase triple pole single throw; gang/operated outdoor type, silver plated contacts with horizontally operating blade and isolators posts arranged vertically. Rotating blade feature with pressure relieving contacts is necessary, i.e. isolators shall have turn and twist arrangement. This arrangement shall be described in details along with the bid. However, the design of turn & twist arrangement shall be to our approval. Banging type feature is not acceptable.

All isolators with/ without earth switch shall operate through 90 degree from their fully closed position to fully open position, so that the break is distinct and clearly visible from the ground level. The Isolators will have manual operating mechanism with worm and reduction gear. The earth switch shall have separate operating mechanism but without worm and reduction gear.

The isolators are not required to operate under load but they must be called upon to handle magnetization currents of the power transformers and capacitive currents of bushings, bus bar connections, very short lengths of cables & current of voltage transformers and dividers.

Material of earthing blades and contacts shall be same as those of main blades and contacts. The earthing blades shall have the same short time current rating (thermal and dynamic) as that of main blades.

5.2 TEMPERATURE RISE:

The maximum temperature attained by any part of the equipment when in service at site under continuous, full load conditions and exposed to the direct rays of sun shall not exceed the temperature limits specified in IS 9921 Part 2. The limit of temperature rise shall not be exceeded when corrected for the difference between ambient temperature at site and the

ambient temperature specified in the approved specifications. The corrections proposed shall be stated in the bid and subject to the approval of the purchaser.

5.3 ISOLATOR INSULATION:

Insulation to ground, insulation between open contacts and the insulation between phases of the completely assembled isolating switch shall be capable of withstanding the dielectric test voltage specified in IS-9921.

The support Insulators shall be solid core type only.

The insulator shall be made of homogeneous and vitreous porcelain of high mechanical and dielectric strength. It shall have sufficient mechanical strength to sustain electrical and mechanical loading on account of wind load, short circuit forces etc.

Glazing of the porcelain shall be of uniform brown or dark brown colour with a smooth surface arranged to shed away rain water. The porcelain shall be free from lamination and other flaws or imperfections that might affect the mechanical or dielectric quality. It shall be thoroughly vitrified, tough and impervious to moisture.

The porcelain and metal parts shall be assembled in such a manner and with such material that any thermal differential expansion between the metal and porcelain parts throughout the range of temperature specified in this specification shall not loosen the parts or create undue internal stresses which may affect the mechanical or electrical strength or rigidity. The assembly shall not have excessive concentration of electrical stresses in any section or across leakage surfaces.

The cement used shall not give rise to chemical reaction with metal fittings. The insulator shall be suitable for water washing by rain or artificial means in service condition.

The insulators shall be fabricated by wet process.

The cement use in the construction of the post insulators shall not cause fracture by expansion or loosening by contraction and proper care shall be taken to locate correctly the individual parts during cementing.

All ferrous metal parts except those of stainless steel shall be hot dip galvanized and the uniformity of the Zinc coating shall satisfy the requirements of IS: 2633, the metal parts shall be galvanized after machining.

The threads of tapped holes in the post insulators metal fittings shall be cut after giving anticorrosion protection and shall be protected against rust, all other threads shall be cut before giving anticorrosion protection. The isolators shall be supplied with mounting base channel with fixed nuts and bolts.

S.No	Description	Requirement
1	No of units per stack	2
2	Nominal system voltage (kV)	220
3	Highest system voltage (kV)	245
4	Insulator height (mm)	2300
5	PCD of metal fittings	
	a. Top	127
	b. Bottom	254
6	Creepage distance	7595
	a. Total	>50% of creepage distance
	b. Protected	
7	Dry flashover voltage (kV)	570
8	Wet flashover voltage (kV)	510
9	Dry withstand voltage (kVrms)	520
10	Wet withstand voltage (kVrms)	460
11	Impulse flashover voltage 1.2/50 μ s wave (kVp)	1150
12	Impulse withstand voltage 1.2/50 μ s wave (kVp)	1050
13	Tensile strength (kN)	110
14	Bending strength (kN)	6

TESTS:

Routine and acceptance tests on the solid core insulators shall be conducted in the presence of purchaser's representative, if so desired by the purchaser all test reports shall be submitted for approval.

5.4 MAIN CONTACTS:

All isolators shall have heavy duty self aligning and high pressure line type fixed contact of modern design and made of hard drawn electrolytic copper. The fixed female contact should be of reverse loop type. The various parts shall be accordingly finished to ensure interchangeability of similar components. The fingers of fixed contacts shall be preferably in three pieces and each shall form the reverse loops to hold moving contacts.

Stopper provided in the fixed contact will overlap inside reverse loop assembly strips to stop over travel of moving contact pipe. It should be made of material having high melting point e.g. Teflon to withstand rise in temperature. The screw to secure the stopper in fixed contact for moving pipe should be flushed properly to avoid damage to moving contact surface.

The fixed contacts would be placed in 'C' clamp. The thickness of Jaw holding bracket ('C' clamp) to hold fixed contact jaws should not be less than 6 mm made of HDG Mild steel. This 'C' clamp shall be placed on a channel of adequate thickness. This channel shall be welded on an insulator mounting plate of 8 mm thickness. The spring of fixed contact shall have housing to hold in place. This spring shall be made of stainless steel minimum

thickness of 14 SWG. The cap on spring should be made of Teflon to withstand rise in temperature. The pad for connection of terminal connector shall be of Aluminium Alloy.

Contact springs shall not carry any current and shall not lose their characteristics due to heating effects.

Each contact or pair of contacts shall be independently sprung so that full pressure is maintained on all contacts at all time.

No undue wear or scuffing shall be evident during the mechanical endurance tests. Contacts and spring shall be designed so that readjustments in contact pressure shall not be necessary throughout the life of the isolator or earthing switch.

Suitable rain hood shall be provided overlapping the bushes on turn twist arrangement to prevent accumulation of dust and other foreign particles so as to avoid jamming of rotation of moving contact pipe. Centre post top pin for holding the turn & twist assembly should be adequate in size to avoid any bending of turn twist mechanism. Nut & bolt arrangement is preferable to hold the pin in place of lock pin. The turn & twist assembly of moving centre post top contact should be provided with sealed ball bearing at centre of mechanism. Flat washers 2 Nos. on each side of turn and twist spring may be provided (4 Nos.). In turn and twist mechanism size of hook lever should not be less than 20 mm.

The switch blades forming the moving contacts shall be made from tubular section of hard drawn electrolytic copper. These contacts shall be liberally dimensioned so as to withstand safely the highest short-circuit and over voltages that may be encountered during service. The surfaces of contacts shall be rendered smooth and silver plated. The thickness of silver plating shall not be less than 25 microns. In nut shell, the male and female contacts assemblies shall be robust construction and design of these assemblies shall ensure

- a. Electro-dynamic with stand ability during short circuit without any risk of repulsion of contacts.
- b. Thermal withstand ability during short circuit.
- c. Constant contact pressure even when the live parts of the insulator stacks are subjected to tensile stresses due to linear expansion of connected bus bar of flexible conductors either because of temperature variations or strong winds.
- d. Self alignment assuring closing of the switch without minute adjustment. The details / drawings of contacts, springs, fixing arrangement, contact pressure, current transfer assembly, limit of temperature rise etc., shall be furnished along with the bid.

The thickness of moving contact pipe should be uniform on the periphery at all points. Due care should be taken to ensure that the copper pipe of good quality from reputed source and of electrolytic grade only is utilized in manufacture of moving contacts. For earth switch the moving contact pipe should be supported with 2 mm thickness brass bushes at rotating points with lubricating facility for smooth operation. The bushes should be machined having one side proper collar and other side to be press fitted. The earthing switches shall each be provided with three sets of suitable type of fixed contacts below the fixed contacts

assemblies of the main switch on the incoming supply side and three sets of moving contacts having ganged operation. These contacts too shall be fabricated out of electrolytic copper for isolators with earth switch and dimensioned to withstand the current on the line. Nut & Bolts of minimum 12 mm size shall be used, except in case of current carrying parts.

5.5 AUXILIARY SWITCHES:

The isolators shall be provided with 220 Volt DC auxiliary switches for their remote position indication on the control board and for electrical interlocking. The auxiliary switch shall have the following number of contacts. The number of contacts shall be decided by the Contractor considering adequate number of contacts for spare and future use.

- a) For all earthing switches: 6 pairs of normally open and 6 pairs of normally closed.
- b) For all main isolators: 14 normally open and 14 normally closed set of contacts.

In addition two pairs of Make-before-break NO/NC contacts shall be provided in the operating Mechanism box.

All contacts should be brought out on terminals. Provision shall be kept for adding more auxiliary switch contacts at a later date. Auxiliary switches shall be of robust construction of reputed make and housed in weather proof, vermin proof, and dust free covers mounted on the respective operating mechanism. Schematic diagram for set of contacts shall be furnished. The auxiliary switches should be positive type. They are spring loaded so that contacts are either NO or NC.

The wire connection to the auxiliary switches shall be through suitable lug screwed to the switch. The connection to the auxiliary switch should be screw on type.

The auxiliary switches shall be capable of carrying the current of at least 10 Amps continuously and shall be capable of breaking at least 2A in 220V DC circuit, with time constant of not less than 20 milliseconds. The auxiliary switches shall be actuated by a cam or similar arrangement directly mounted on the isolator and shall be without any intermediate levels/ linkages to ensure fool proof operation.

It shall be possible to change normally closed contact into normally open contacts and vice versa at site.

5.6 ISOLATOR & EARTH SWITCH OPERATION:

Each 245 kV motor operated isolator switch shall be equipped with a local manual operating device with worm & reduction gear. It shall be possible to pad lock the manual operating handle both in the open and close positions of the switches. Additional castle type outer lock shall be provided on the manual operating handle and control cubicle to prevent the operation of isolator manually & locally when the corresponding circuit breaker is 'ON'. The earth switch may be local manual operated by separate mechanism without worm &

reduction gear.

Operating mechanisms for main switch & earth switch should be provided with flexible copper strips for earthing of handle.

5.6.1 OPERATING MECHANISM:

The bidder shall offer motor operated Isolators and earth switches as well as manually operated mechanism.

The Isolators and earthing switches shall have separate dependent operating mechanism.

The earth switch shall have simple manual operating mechanism. The operating mechanism should be such that the blade goes very smoothly in the fixed contact. There should not be any jerk during operation. The earth switch plate should not move due to gravity.

In the rotating insulator, the design should be such that the shaft length is enough to accommodate the locknut in a proper manner. The isolators and isolator with earth switches inclusive of their operating mechanism should be such that they cannot come out of their open or closed positions by gravity, wind pressure, vibrations reasonable shocks, or accidental touching of connecting rods of the operating mechanism. Isolators and earth switches should be capable of resisting in closed position, the dynamic and thermal effects of maximum possible, short circuit current at the installation point.

ON/OFF marking shall be indicated on operating mechanism of main switch and earth switch. Direction will also be indicated. Proper locking arrangement with lock & key of operating handle in ON & OFF position should be provided. Limit switches for control shall be fitted on the isolator shaft within the cabinet to sense the open and close positions of the isolators and earth switches. It shall not be possible, after final adjustment has been made, for any part of the mechanism to be displaced at any point in the travel sufficient enough to cause improper functioning of the isolator when the isolator is opened or closed at any speed. All holes in cranks, linkage etc, having moving pins, shall be drilled to fit accurately so as to maintain the minimum amount of slack and lost motion in the entire mechanism

5.6.2 MOTOR OPERATING MECHANISM:

The control schematics of motor operating mechanism shall actuate 3 pole group operated switches or individual drive switches to operate the electric motor in proper direction. There will be additional contacts, which will switch on power supply to motor on receipt of open/close command.

The operating mechanism shall normally be operated by remote control. Local electrical closing and opening facilities shall also be provided. For this purpose the following items shall be provided.

1. 3 - Way control switch with local / remote/ off position.

2. Push button for 'open'.
3. Push button for 'close'.

To cut off the 220 volts DC supply to closing and opening coils after completion of closing and opening operations, isolators shall be provided with limit switches which shall disconnect the supply at the proper moment of completion of operation.

The motor mechanism shall be connected to the isolator torsional control through a suitable reducing gear coupling assembly. Suitable means to limit over travel shall be provided and stated in the bid.

Motor shall be direct on line starting type conforming to IS: 325. Gear drive assemblies shall be suitable for operating the isolator with minimum of energy. The motor enclosures shall conform to IP-55. The motor shall develop stalled torque equal to at least 2.5 times the torque required to operate the isolator.

Emergency manual operation shall be provided to enable operation of isolator in case of power failure. During manual operation of isolator power operation shall be in-operative. Arrangement shall be made to padlock the emergency handle when not in use.

Limit switches for motor control shall be fitted on the isolator shaft, within the cabinet, to sense 'Open and Close' positions of the isolator to cut off the power supply to the motor at appropriate instant. The control schematics shall be such that in case of stalling of motor power supply to motor, it shall be automatically tripped after the predetermined time and shall remain tripped till restored by the operator. Indication for such auto tripping shall be provided in, local as well as remote control cabinet. The motor shall be provided with single phase prevents, short circuit protection and over load protection.

The mechanism shall stop immediately when motor supply is switched off. A quick acting electro mechanical brake shall be provided on higher speed shaft.

Manual operation facility (with handle) should be provided with necessary interlock to disconnect motor

5.7 CONTROL CABINET:

The control cabinet of the operating mechanism shall be made out of 12 SWG (2.64 mm thick) sheet steel duly hot dip galvanised or 10 mm thick aluminium plate or casting.

The Cabinet shall have adequate channel support to withstand weight of gear. 2 Nos. rectangular frames made of 50x50x6 mm angle shall be provided to fix gear operating box on structure angles 20 x 14 mm slots both in horizontal and vertical direction will be provided on gear operating box support to facilitate adjustment for fixing.

Hinged door shall be provided with pad locking arrangement. Sloping rain hood shall be

provided to cover all sides. 15 mm thick neoprene or better type of gaskets shall be provided to ensure degree of protection of at least IP 55 as per IS: 2147.

The cabinet shall be suitable for mounting on support structure with adjustment for vertical alignment. Details of these arrangements shall be furnished along with the bid.

The unsupported length of the operating rod shall not exceed 3 meters. Guide bearings shall be provided at suitable intervals.

All brackets angles or other members mid accessories necessary for fixing the operating mechanism to support structure and the bearing for operating rods shall be supplied.

Rust proof pins and bearings of the bronze bushing, ball or roller type shall be provided. All ball and roller bearings shall be protected from weather by means of covers and grease retainers. Bearing pressures shall be kept low to ensure long life.

5.8 GEAR:

The isolators may be required to operate occasionally with considerable long idle intervals. Special care shall be taken for selection of material of gear to meet this requirement. The gear shall be made of forged material suitably chosen to avoid bending/jamming on operation after a prolonged period of non operation. Also all gear and connected material should be so chosen/surface treated to avoid rusting and lubricated for life with suitable lubricant. Gear operating box should be properly sealed to prevent any leakage of grease / lubricating material. Provision for future lubrication should also be made. The gear box enclosure should be made by casting process and not of sheet steel to provide proper gear alignment. It should be filled with graphite grease or non hardening grease. Complete details of component, material and grade, lubricant material and grade shall be furnished in the bid.

5.9 PIPES:

Tandem pipes and operating handle shall be class B pipe having at least 40 mm internal diameter. The operating pipe shall also be class B with internal diameter of at least 50mm. The pipe shall be terminated into suitable universal type joints between the insulator bottom bearing and operating mechanism. Bushes may be provided on coupling of tandem pipe with insulator rotating base (3Nos.). Bushes may also be provided on both sides of operating down pipe (2 Nos.) at support clamps. Bushes shall be made by machining process for smooth movement and should have minimum thickness of 2 mm. Bushes should be machined having one side proper collar and other side to be press fitted. Flange type joint should be provided at the bottom and universal coupling at top of down operating pipe to avoid any play during operation.

5.10 BASE CHANNELS:

The isolator shall be mounted on a base fabricated from steel channel section of adequate size not less than 125x65 mm to withstand total weight of Isolator and insulators and also all the forces that may encountered by the isolator during service. The strengthening / jointing of base channels should be made by same size channels, to eliminate any vibrations during operations. Mounting plates for insulators shall be big enough to properly accommodate insulator metal parts (Base flanges). For fixing of bearing housing one M.S. plate of 8 mm thickness should be welded on mounting channels, covering entire width of mounting channel base. The M.S. Plate will have slotted round hole in the middle for accommodating bearing assembly. The steel channel in each phase shall be mounted in vertical position and over it two mounting plates at least 8 mm thick with suitable nuts and bolts shall be provided for minor adjustment at site. Suitable marking on various parts including mounting channel should be provided for proper identification.

5.11 TERMINAL BLOCK & WIRING:

Each operating mechanism shall be provided with 1100 V grade stud type terminal block having washers, nuts & check nuts. All auxiliary switches, interlocks and other terminals shall be wired up to terminal block. The terminal block shall have at least 20% extra terminals. All wiring shall be carried out with 1100 V grade insulated 2.5 mm² copper wires.

Separate terminal blocks of stud type for AC or DC wiring shall be provided in the cabinet. The ends of wires shall be provided with tinned terminal spade crimped on to the wires. The wiring connected with the heaters in the panel shall be provided with porcelain beaded insulator for a short distance from the heater terminal. No joints shall be permitted in the wiring.

All spare contacts of relays, push button, auxiliary switches etc., shall be wired up to the terminal blocks in the mechanism box.

The fuses provided with motor and heater circuit shall be cartridge type (HRC) with suitable fittings.

Insulating barriers shall be provided between adjacent connections.

All relays, contactors and other electrical devices mounted in the panel shall have name plates with a rating data and manufacturer's name, etc., Suitable identification label shall also be provided for control switches and fuses etc. including position indications of isolator / earth switch.

5.12 INTERIOR ILLUMINATION:

A switch, HRC fuse and holder suitable for a 240V lamp shall be provided in the mechanism box of isolator and operating mechanism box of earth switch.

5.13 SPACE HEATERS:

Space heater thermostatically controlled, suitable for single phase 240V AC supply shall be provided for operating mechanism to prevent condensation. A switch and fuse/link shall be provided in the operating mechanism.

5.14 POWER SOCKET:

A single phase 240 V 15A power socket and switch shall be provided in the Operating mechanism.

5.15 ACCESSORIES:

The accessories to be provided on the isolator shall include but not limited to the following:

POSITION INDICATOR:

A position indicator to show whether the isolator is in ON or OFF position

COUNTER BALANCE SPRINGS:

Counter balance springs, cushions etc., shall be provided to prevent impact at the end of travel both on opening and closing of the isolator. The springs shall be made of durable and non rusting type alloy.

5.16 NAME PLATE:

Isolator and Earth switches and their operating devices shall be provided with a name plate. The name plate shall be weather proof and corrosion proof. It shall be mounted in such a position that it shall be visible in the position of normal service and installation. It shall carry the following information duly engraved or punched on it.

Isolator Base:

Name of utility:

Name of Manufacturer:

P.O. No. :

Type Designation:

Manufacturer's serial number:

Rated voltage:

Rated normal current:

Rated short time current (rms):

and duration :

Rated short time peak current (kAp) :

Weight:

Earth Switch:

Name of utility:

Name of Manufacturer:

P.O. No. :

Type Designation:

Manufacturer's serial number:

Rated voltage:

Rated normal current:

Rated short time current (rms):

and duration :

Rated short time peak current (kAp):

Weight:

Operating Device:

Name of utility:

Name of Manufacturer:

P.O. No. :

Type Designation:

- Reduction gear ratio:
- Space Heater:
- Rated voltage and power Auxiliary contacts
 - i. Rated current (Amps) :
 - ii. Time constant (ms) :
 - iii. No. of contacts used (NC & NO) :
 - iv. No. of free contacts (NC & NO) :
- Terminal blocks and wiring
 - i. Rated current :
 - ii. Voltage grade and type :

5.17 SIGNALLING:

Signalling of the close position shall not take place unless the movable contact has set in a position in which the rated normal current, the peak withstand current and the short time withstand current can be carried safely.

Signalling of the open position shall not take place unless the movable contact has reached the position such that the clearance between the moveable and fixed contacts is at least 80% of the isolating distance.

5.18 EARTHING:

Flexible copper connections shall be provided between rotating earth blades and the frame which shall have a cross-section of at least 50 mm² and shall be tinned or suitably treated against corrosion.

The frame of each isolator and earth switch shall be provided with two reliable earthing terminals for connection to the earthing conductor/flat and also clamping screws suitable for carrying specified short time current. Flexible ground connections shall be provided for connecting operating handle to the earthing flat. The diameter of clamping screw shall be at least 12 mm. The connecting point shall be marked with earth symbol.

5.19 FASTENERS:

Nuts, bolts and washers of 5/8" and higher size shall be hot dip galvanised. The bolts used on tapped holes of insulator cap shall be galvanised by centrifuge process to avoid excess deposition of zinc on threads. Nuts, bolts and washers of less than 5/8" size shall be of stainless steel when used on live parts and nickel plated brass in other parts.

5.20 MOUNTING OF CONTACTS:

The contacts shall rest on a brass block and with initial tension. Suitable device shall be provided to prevent dashing. Fabrication, welding etc., shall be done in suitable jig to avoid deviations during production.

5.21 TERMINAL PAD:

The terminal pad shall be suitable for connection to aluminium terminal connector through bimetallic plate wherever necessary. It shall be made out of electrolytic copper heavily silver plated. Dimensions of the terminal pad shall be furnished with the Bid.

5.22 INTERLOCKS AND EARTH SWITCHES:

Line earth switches shall consist of three earthing links per isolator which will normally rest against the frame when the connected isolator is in closed position. The earthing links for

the three phases shall be mechanically linked to a coupling shaft which shall be capable of being fitted on either side of the isolator. Earth switch shall be mechanically interlocked with the main switch so that it is possible to close or open the earth switch only when the main switch is in the open position & its closing operation shall not be possible. Therefore, the earthing switches should be provided with counter balance weight so that the earth switches do not fall due to gravity and it moves very smoothly in upward direction i.e. against gravity. The length of lever and counter weight should be selected carefully so that earth switch is in horizontal position in fully opened condition. Each earthing switch shall be designed to withstand electrodynamic stress due to currents up to 50 kA (peak) as per IEC recommendations. The contacts shall be of silver plated copper only.

All shafts, couplings etc shall be galvanised. Flexible copper connectors of at least 50sq.mm cross-section shall be provided between the rotating shafts and the frame work.

The operation of isolator shall be possible only by means of only one device at a time, i.e., either manually or on motor operation. Adequate means shall, however be provided to make manual operation of isolator possible in the event of failure of auxiliary DC supply to isolator operating mechanism. Under such contingencies also, the isolator operation shall be duly interlocked with the circuit breaker so that the manual operation by means of the operating handle is possible only when the circuit breaker is in the open position. The isolator mechanism box shall consist of solenoid operating device, which shall prevent insertion of manual opening handle, when the associated circuit breaker is closed, by energizing the solenoid through the circuit breaker auxiliary circuit. The isolator shall be suitable for provision of castles mechanical locks / interlocks for which drawings shall be supplied by the purchaser after placement of orders. The interlock shall be provided along with each earth blade assembly such that operation of earth blade assembly is possible only when the associated isolators are locked in the open position by integral lock. The design of the earthing blade assembly shall be such as to permit use of a pad lock, for locking the operating handle of the earthing blade assembly in the open or in the closed position.

5.23 BEARINGS:

The design and construction of the various bearings shall embody all the features required to withstand climatic conditions specified, so as to ensure dependable and effective operation even after long periods of in-action of these isolators and switches. Bearing housings should be weather proof. Facilities should be provided for lubrication of bearings. The location and number of bearings provided for reducing friction shall be clearly intimated along with suitable drawings. The bearing housing shall be made of gravity die-cast aluminium with smooth surface suitably machined for sealing the bearings. Each bearing assembly shall have two nos. (Taper roller thrust and ball) bearing with adequate shaft diameter. A minimum distance of 100 mm between thrust and ball bearings shall be provided to avoid wobbling during operation. The bearings shall be of reputed make e.g. SKF, HMT, NBC, and TATA & lubricated for life. All other friction locations shall be provided with suitable bearings/ stainless steel or brass bushes. Complete details of arrangement offered shall be furnished.

5.24 SUPPORTING STRUCTURE:

The supporting structure shall be supplied by the purchaser. The successful Agency shall

provide all load details for design and fabrication of the structure for mounting of isolator and earth switch.

5.25 DESIGN, MATERIAL AND WORKMANSHIP:

The successful Agency shall assume full responsibility for co-ordination and adequate design. All materials used in the construction of the equipment shall be of the appropriate class, well finished and of approved design and name. All similar parts should be accurately finished and inter-changeable.

5.26 PAINTING, GALVANISING AND CLIMATE PROOFING:

All interiors and exteriors of control cabinets shall be thoroughly cleaned to remove all rust, scales, corrosion, grease and other adhering foreign matter and the surfaces treated by recognized phosphate (e.g seven tank phosphate sequences). After such preparation of surfaces, two coats of zinc oxide primer shall be given by suitable staving and air drying before final painting. Colour of the final paints shall be of shade No. 697 of ISI i.e. epoxy light gray. The finally painted cubicle shall present aesthetically pleasing appearance free from any dent or un-even surface. Paint inside the metallic housing shall be of anti-condensation type and the paint on outside surfaces shall be suitable for outdoor installation. All components shall be given adequate treatment of climate proofing as per IS-3202 or equivalent international standard so as to withstand corrosive and severe service condition. All ferrous parts shall be heavily hot dip galvanised. Bolts, nuts, pins and washers, etc. used on the isolators shall also be galvanised. All the nuts, bolts and washers in current carrying parts shall also be of hot dip galvanised. Special attention shall be aid to give tropical treatment to all the equipment as it will be subjected during service to extremely severe exposure to atmospheric moisture and to long period of high ambient temperature. All current carrying parts shall be of non-ferrous metal or alloys and shall be designed to limit sharp point edges and similar sharp faces.

6.0 TESTS:

6.1 TYPE TEST:

All the equipment offered, shall be fully type tested as per IS 9921- Part 4 (IEC62271-102). Copy of test reports shall be enclosed with the bid. For any change in the design/type already type tested and the design/type offered against this bid, M/s. TFL/OPTCL have rights to demand repetition of same or all type tests without any extra cost.

6.2 ACCEPTANCE & ROUTINE TESTS:

- a) The manufacturer shall carry out all acceptance and routine tests as stipulated in the relevant Indian Standards or equivalent International Standards in presence of purchaser's representative.
- b) Immediately after finalisation of the programme of type / acceptance / routine testing, the manufacturer shall give sufficient advance intimation to M/S TALCHER FERTILIZER LIMITED, to enable him to depute his representative for witnessing the tests.

7.0 INSPECTION:

- a) M/S TALCHER FERTILIZER LIMITED shall have access at all times to the works and all other places of manufacturer, where the isolators are being manufactured and the successful Agency / Manufacturer shall provide all facilities for unrestricted inspection, raw materials, manufacture of all the accessories and for conducting necessary tests as detailed herein.
- b) The successful Agency shall keep the Purchaser informed in advance of the time of starting and of the progress of manufacture of equipment in its various stages, so that arrangements could be made for inspection.
- c) No material shall be dispatched from the point of manufacture unless the material has been satisfactorily inspected and tested.
- d) The acceptance of any quantity of the equipment shall in no way relieve the successful Agency of his responsibility for meeting all the requirement of this specification and shall not prevent subsequent rejection if such equipment are later found to be defective.

8.0 QUALITY ASSURANCE PLAN & STAGE INSPECTION:

The successful Agency shall ensure that for the purpose of supply of equipments, the manufacturer will have to follow strict quality assurance program me, which will include thorough verification of samples of critical assemblies and accessories, verification of sources of raw materials, detailed verification of drawing & design, checking up of relevant calculations, stage inspections at various critical stages of manufacture and minor modifications consequent to such stage inspections as per our requirements and all other related requirements, which have generally been brought out in bidding documents and the detailed contract. It is expected that bidder would be very serious and prudent in meeting these requirements without any loss of time, so that supply of equipments in line with quality assurance program me is ensured within targeted schedule.

M/S TALCHER FERTILIZER LIMITED reserves the right to specify various stages for stage inspections and also for manufacture of a proto type unit for inspection & testing, before according clearance for bulk manufacturing.

The bidder shall ensure that manufacturer must establish that they are following a proper quality assurance program me for manufacture of offered equipments.

The bidder shall ensure that manufacturer invariably furnish following information:-

- (i) Statement giving list of important raw materials, names of sub supplier for the raw material, list of standards according to which the raw material are tested, list of tests normally carried out on raw material in presence of manufacturers representative, copies of test certificates.
- (ii) Information and copies of test certificates as in (i) above in respect of bought out items.
- (iii) List of manufacturing facilities available.

- (iv) Levels of automation achieved and list of areas where manual processing exists.
- (v) List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspection.
- (vi) Special features provided in the equipment to make it maintenance free.
- (vii) List of testing equipment available with the manufacturer for final testing of equipment specified and test plant limitations, if any vis-à-vis type, special, acceptance and routine tests specified in the relevant Indian Standards or equivalent international standard. These limitations shall be very clearly brought out in schedule of deviations from specified test equipments.

The successful Agency shall arrange Quality Assurance Plan (QAP) with hold points for M/S TALCHER FERTILIZER LIMITED's inspection within 30 days of award of Contract.

The successful Agency shall also ensure that the manufacturer submits the routine test certificates of bought out items and for raw material at the time of routine testing of the fully assembled equipment.

9.0 DOCUMENTATION

All drawings shall conform to latest version of international standards organization (ISO) 'A' series of drawing sheet/Indian Standards Specification IS-11065. All drawings shall be in ink and suitable for micro filming. All dimensions and data shall be in S.I. Units.

LIST OF DRAWINGS AND DOCUMENTS

The successful Agency shall furnish four sets of following details during detailed engineering;

- (i) Complete assembly drawing showing plan and elevation views of the isolator, complete with details of operating mechanism, mounting dimensions etc.
- (ii) Sketches and descriptive details of:
 - a) The outline dimensions of the isolating and earth switches.
 - b) Details of main contacts.
 - c) The mechanical interlock between earth and isolating switches.
 - d) The details of fixed and moving contacts and the arrangement of pressure relief.
 - e) Turn and Twist mechanism.
 - f) Bearing assembly.
 - g) Terminal connectors.
 - h) Name plates to be provided.
 - i) Operating mechanism, type of gear, size & thickness of box, gland plate etc
- (iii) Drawings with details to substantiate the suitability of the jaw design.
- (iv) Type Test reports in case the equipment has already been type tested.

The successful Agency shall within two weeks of placement of order, submit four sets of final versions of all the above drawings for Purchaser's approval. The Purchaser shall communicate his comments/approval on the drawings to the successful Agency within

reasonable time. The successful Agency shall, if necessary, modify the drawings and resubmit four copies of the modified drawings for Purchaser's approval within two weeks from the date of Purchaser's comments. After receipt of Purchaser's approval, the successful Agency shall within three weeks submit 2 prints and two good quality reproducible of the approved drawings for Purchaser's use.

The successful Agency before commencement of supply shall submit two sets of the type test reports, duly approved by the Purchaser. Two copies of acceptance and routine tests certificates, duly approved by the Purchaser shall accompany the dispatched consignment.

The manufacturing of the equipment shall be strictly in accordance with the approved drawings and no deviation shall be permitted without the written approval of the Purchaser. All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawing shall be at the successful Agency's risk.

Two copies of nicely printed and bound volumes of operation, maintenance and erection manuals in English Language, for each type and rating of equipment supplied shall be submitted by the successful Agency for distribution to field officers prior to the dispatch of the equipment. The manual shall contain all the drawings and information required for erection, operation and maintenance of the equipments. The manual shall also contain a set of all the approved drawings, type test reports etc.

Approval of drawings/work by M/S TFL/OPTCL shall not relieve the successful Agency of his responsibility and liability for ensuring correctness and correct interpretation of the latest revision of applicable standards, rules and codes of practices. The equipment shall conform in all respects to high standards of engineering, design, workmanship and latest revisions of relevant standards at the time of ordering and Purchaser shall have the power to reject any work or material, which in his judgment is not in full accordance there with.

10.0 PACKING AND FORWARDING:

Successful Agency/Manufacturer shall ensure that the equipment shall be packed in crates suitable for vertical / horizontal transport, as the case may be and suitable to withstand handling during transport and outdoor storage during transit.

11.0 DEVIATION FROM TECHNICAL PARTICULARS:

No deviation from technical particulars of equipments and materials will be allowed, which may please be noted.

12.0 GUARANTEED AND OTHER TECHNICAL PARTICULARS:

The bidder shall furnish all the particulars as per format in Annexure-1.

ANNEXURE-1

SCHEDULE OF GUARANTEED AND OTHER TECHNICAL PARTICULARS

GUARANTEED TECHNICAL PARTICULARS FOR 245 KV ISOLATOR		
Sl.no	Description	To be filled by the bidder
1	General	
a)	Name of Manufacturer	
b)	Manufacturer's type designation	
c)	Standard applicable for Isolators and earth switches	
d)	Rated voltage (kV)	
e)	Rated current under site conditions @ 40°C ambient	
f)	Rated frequency (Hz)	
g)	Number of poles	
h)	Whether all 3 poles are ganged mechanically	
i)	Phase to Phase spacing	
j)	Type of Installation	
2	Guaranteed rating	
a)	Rated short time current of isolator (kA) and dynamic current (kAp)	
b)	Temperature rise over 40°C ambient temperature corresponding to maximum continuous current (°C)	
c)	Opening time of isolator and earth switch(S)	
d)	Closing time of isolator and earth switch(S)	
3	Dielectric withstand capacity of completely assembled isolator / isolator and earth switch	
a)	One minute dry power frequency withstand test voltage (kV rms)	
	i. Against ground (kV rms)	
	ii. Across isolating distance (kV rms)	
b)	1.2/50 μ s impulse withstand test voltage	
	i. Against ground (kVp)	
	ii. Across isolating distance (kVp)	
c)	Corona extinction voltage (kV rms)	
d)	Radio interference level at 1.1 Ur/_/3 (micro volts at 1.0 MHz)	
e)	Total creepage distance to ground (mm)	
4	Safe duration of overload	
a)	150% of rated current	
b)	120% of rated current	
5	Capacity to interrupt magnetizing current (A)	
6	Capacity to interrupt line charging current (A)	
7	Operating Mechanism	

A)	For Main Blades	
	i. Type	
	ii. Manufacturer's Type designation	
	iii. Rated torque of the mechanism (Kg-m)	
B)	For Earth Switches	
	i. Type	
	ii. Manufacturer's Type / Designation	
	iii. Rated torque of the mechanism	
8	Interlocks	
a)	Whether mechanical/ Constructional interlock between isolator & earth switch provided	
b)	Details of electrical interlock enclosed for	
	i. Isolator	
	ii. Earth switch	
c)	Arrangement provided to prevent electrical or manual operation unless interlock conditions are satisfied	
d)	whether Interlock coil is continuously rated	
e)	Rated DC control voltage and variation allowed	
f)	Power consumption (W)	
9	Controls	
a)	Rated DC control voltage (V)	
b)	Limits of Voltage	
c)	Power consumption of control coils (W)	
10	Constructional features	
a)	Minimum clearance in air	
	i. Between Phases (mm)	
	ii. Between live parts to earth (mm)	
	iii. Distance between terminals of same phase(mm)	
b)	Whether position of earth switch can be interchanged at site to either side of pole	
c)	Minimum clearance between live part and earth switch blade throughout the entire operation arc of earth switch (mm)	
d)	Terminal pad details	
	i. Diameter & length	
	ii. Material of pad	
e)	Insulator data	
	i. Height	
	ii. Type	
	iii. No of insulator stacks/phase	
	iv. No of insulators/stack	
f)	Main contacts	
	i. Type of contacts	

	a) Moving Contact	
	b) Fixed Contact	
	ii. Contact area (Cm ²)	
	a) Moving Contact	
	b) Fixed Contact	
	iii. Material of contacts	
	iv. Contact pressure (Kg/cm ²)	
	v. Maximum current density under normal current carrying capacity (A/cm ²)	
	a) Moving Contact	
	b) Fixed Contact	
	c) Terminal	
	vi. Thickness of silver plating.	
g)	Number of auxiliary contacts on isolator/pole for Owner's use	
	a) Manually Operated	
h)	Number of auxiliary contacts on earth switch/pole for Owner's use.	
i)	Auxiliary contacts	
	i. Rated voltage(V)	
	ii. Rated continuous Current (A)	
	iii. Rated DC breaking current with 20 rms time constant	
j)	Mounting dimensions isolators	
	i. Distance between supports	
	ii. Top dimensions of support.	
k)	Height from mounting plane to top of terminal stud	
l)	Whether cable glands required included in the scope for inter pole cabling to be done by the Owner.	
11	Motor details	
a)	Rated voltage (v)	
b)	Rated current (A)	
c)	Type of motor	
d)	Conforming standard	
e)	Other details if any	
12	Literature	
	Whether the following are enclosed	
a)	Type test reports as per IEC 129	
b)	OGA drawings for isolator with & without earth switches.	
c)	Operation manual for isolators	
d)	Details of motor operating/manually driven mechanism.	
e)	Recommended drawing for mounting details for insulator and drives.	
f)	Leaflets & literature bringing out salient features of equipment offered.	
g)	Details of constructional interlock.	

13	Control Cabinets	
a)	Manufacturer's name	
b)	Indoor / Outdoor application	
c)	Standards applicable	
d)	Design ambient air temp(°C)	
e)	Thickness of sheet steel (mm) and whether cold rolled or hot rolled.	
f)	Degree of protection provided.	
g)	Bill of material for all the equipment mounted on control cabinet giving the following details:	
	a) Make and type.	
	b) Applicable Standard.	
	c) Voltage rating.	
	d) Current rating.	
	e) Duty class, if applicable.	
	f) Manufacturer's Catalogue No.	
	g) Total heat load of cabinet (for purpose of ventilation requirement).	
h)	Colour of finish paint IS : 5	
	a) Outside.	
	b) Inside.	
i)	Control wiring	
	a) Size of Conductor	
	b) . i). for CT circuits.	
	ii). for other circuits.	
	c) Conductor Solid/Stranded.	
	d) Number of Strands/Conductor	
j)	Terminal blocks	
	a) Make & Type.	
	b) Current rating.	
	i. Power terminals(A).	
	ii. Other terminals(A).	
k)	Space Heater Rating at 240 V AC	
l)	Control cabinet drawing showing the following a) Outline dimensions floor openings floor / wall / pedestal fixing arrangements weights, b) Front view, inside view showing the mounting arrangement of various equipment	
m)	Schematic/wiring diagram of control cabinet enclosed.	
n)	Interconnection drawing showing Owner's external cable, connections to the control cabinet	
o)	Type test report to verify degree of protection enclosed.	
p)	Details of Terminal rows	

	a) Whether arranged vertical or horizontal.	
	b) Clearance from adjacent components.	
	c) Distance between rows.	
	d) Whether transparent protection cover provided.	
14	SUPPORT INSULATOR	
1	Manufacturer's Name	
2	Type	
3	Applicable Standards	
4	Height	
	i. Diameter(Top)	
	ii. Diameter(Bottom)	
5	Total Creepage distance (mm)	
6	Rated Voltage (kV)	
7	Power frequency withstand voltage for 1 min. (kVrms) dry and wet.	
8	1.2/50 micro sec. Impulse withstand voltage(kVp)	
10	Corona Extinction voltage (kV)	
11	Net Weight (kg)	
12	Max.Allowable Span(mm)	
13	Cantilever strength (kg)	
14	OGA drawing enclosed	
15	Tensile strength. (KN)	
16	Compression strength. (KN)	
17	Torsion failing load (KN-m)	
18	Bending strength (KN)	

PART-9
216kV OUTDOOR LIGHTNING ARRESTER

TECHNICAL SPECIFICATIONS FOR 220KV OUTDOOR LIGHTNING ARRESTER

1.0 SCOPE:

This specification covers the design, engineering, manufacture; stage testing, inspection and testing before dispatch, packing, forwarding and delivery at the site of Metal oxide (gapless) surge arresters with discharge counter, insulating base and other accessories for 220/33kV TFL Substation, specified here under.

It is not the intent to specify completely herein all the details of design and construction of surge arresters. However, Surge Arrester shall conform in all respects to the high standards of design and workmanship and be capable of performing in continuous commercial operation up to Successful Agency's guarantee in a manner acceptable to purchaser, who will interpret the meanings of drawings and specifications and shall have the power to reject any work or material which in his judgments are not in accordance therewith. The arresters offered shall be complete with all parts, necessary for their effective and trouble free operation. Such components shall be deemed to be within the scope of supply, irrespective of whether they are specifically brought out in the commercial order or not.

2.0 STANDARDS:

2.1 The Surge arresters shall conform to the latest editions and amendments available at the time of supply of the standards listed hereunder and in accordance with requirement specified in the specification.

Sl. No.	Indian Standard	Title	International Standard
1		Metal-oxide surge arresters without gaps for a.c systems	IEC 60099-4
2	IS-3070-3	Lightning arresters for alternating current systems - Specification	
3		Surge arresters – Selection and Application recommendations.	IEC 60099-5
4	IS-2629	Recommended practice for Hot dip galvanizing for Iron & Steel	
5	IS-4759	Hot dip zinc-coating on structural steel and other allied products	
6	IS 2633	Method for testing uniformity of coating on zinc coated articles	
7	IS 5621	Specification for large hollow porcelain for use in electrical installation	
8	IS 5561	Specification for Electric Power Connector	
9	IS:2147	Degree of protection provided by enclosures for low voltage switchgear and control	

10		Indian Electricity Rules, 1956	
11	OISD - RP - 149	Design aspects for safety in electrical system	
12	OISD – STD – 173	Fire prevention and protection system for electrical installations	

Surge Arrestors meeting with the requirements of other authority standards, which ensure equal or better quality than the standards mentioned above shall also be acceptable where the equipment offered by the bidder conforms to other standards, salient points of difference between the standards adopted and the specified standards shall be clearly brought out in the offer. Four copies of the reference standards in English languages shall be furnished along with the offer.

3.0 CLIMATIC CONDITIONS.

The Surge arresters to be supplied against this specification shall be suitable for satisfactory and continuous operation under the following tropical conditions listed below.

S.No	Particulars	Conditions
1.	Maximum ambient air temperature ($^{\circ}\text{C}$)	50
2.	Minimum ambient air temperature ($^{\circ}\text{C}$)	5
3.	Relative humidity for design of equipment	100 % (max)
4.	Average rainfall per annum (mm)	1500
5.	Maximum altitude above mean sea level (m)	less than 1000
6.	Basic wind speed (m/s)	50
7.	Isokeraunic level (days/year)	70
8.	Seismic level	Zone-3
9.	Degree of Pollution	Very Heavy (7595 mm)
10.	Site location	Angul District, State of Odisha

4.0 PRINCIPAL PARAMETERS.

Sl.No.	Description	Parameters
1.	Nominal system voltage (kV)	220
2.	Highest system voltage (kV)	245
3.	Rated arrester voltage (kV)	216
4.	Rated system frequency (Hz)	50
5.	Installation	Outdoor
6.	System Fault Level (kA)	50 kA for 1 Sec
7.	Continuous operating voltage (COV), kV rms	175
8.	Nominal discharge current corresponding to 8/20 μ s wave shape (kA)	10
9.	Minimum energy discharge capability (as per long duration discharge class of IEC- 99-4) in kJ/kV	10
10.	Long duration discharge class	3
11.	Neutral Grounding	Effectively earthed
12.	Maximum residual voltage at nominal discharge current of 8/20 micro sec. wave for	
	a) 5 kA	560kVp
	b) 10 kA	600kVp
	c) 20 kA	-
13.	High current short duration impulse withstand level with 4/10 micro sec. wave kA (Peak)	100 KAp

14.	Creepage distance of porcelain housing (mm)	7595
15.	Pressure relief class	Class A
16.	Insulation level of housing (Lightning Impulse withstand voltage) kVp	1050
17.	Cantilever strength (kgf)	150

5.0 GENERAL TECHNICAL REQUIREMENT:

5.1 The Surge Arrestor shall conform to the technical requirements as per Clause 4.0.

5.2 Duty Requirements:

- The surge arrester shall be of heavy duty station class and gapless type without any serious or shunt gaps.
- The surge arresters shall be capable of discharging over voltage occurring during switching of long lines.
- The duty cycle of CB installed in 245kV System of the Purchaser shall be O-0.3 sec-CO-3 min-CO. The Surge Arrester shall be suitable for such circuit breaker duties in the system.

5.3 The graph for Temporary over Voltage (TOV) capability should be submitted along with the bid.

5.4 The Surge arrester shall be suitable for Hot line washing.

5.5 Protective Levels:

The basic insulation levels of the equipments to be protected have been specified in below table. The protective characteristics of the arresters offered shall be clearly specified in the schedule of guaranteed technical particulars.

	220kV
a. Lightning impulse voltage withstand level(kVp)	
For transformer	1050
For other equipments & line	1050
b. Power frequency withstand level(kV rms)	
For transformer	460
For other equipments & line	460

5.6 Sealing:

Each and every individual unit of surge arrester shall be hermetically sealed and fully protected against ingress of moisture. The hermetic seal shall be effective for entire lifetime of arresters and under the service conditions specified. The Successful Agency shall furnish sectional view showing details of sealing employed. Complete details of sealing arrangement may please be furnished.

5.7 Grading Ring:

The grading ring on each complete arrester may be provided for proper stress distribution corona ring shall be provided if required for attaining all relevant technical parameters.

5.8 Pressure Relief Device:

The surge arresters shall be fitted with pressure relief devices and arc diverting ports and shall be tested as per the requirements of IEC 60099-Part 4 for minimum prospective symmetrical fault current as specified in Clause 4.0.

5.9 Interchange ability:

All the units of arresters of same rating shall be interchangeable without adversely affecting the performance.

5.10 Mounting:

- a) The surge arresters shall be suitable for pedestal type mounting which will be arranged by the purchaser. The mounting of surge arresters shall be suitable as per structure drawing to be provided by the purchaser.
- b) All necessary bolts, nuts, clamps etc., required for mounting of surge arrester on support structure to be supplied by the Successful Agency. It shall be included in bidder's scope of supply.

5.11 Porcelain Bushing:

- a) All porcelain housing shall be free from lamination cavities and other flaws affecting the maximum level of mechanical and electrical strength.
- b) The porcelain shall be well vitrified and non-porous.
- c) The creepage distance of the arrester housing shall comply with the requirement indicated in Clause 4.0.
- d) The porcelain petticoats shall be preferably of self-cleaning type (Aerofoil design). The details of the porcelain housing such as height, angle of inclination, shape of petticoats, gap between the petticoats, diameter (ID and OD) etc., shall be indicated by the Successful Agency in the form of a detailed drawing.
- e) The arrester housing shall conform to the requirements of IEC/ IS.
- f) Porcelain housing shall be so coordinated that external flashover will not occur due to application of any impulse or switching surge voltage upto the maximum design value for arrester.
- g) The arresters shall not fail due to arrester porcelain contamination.
- h) The end fittings shall be made of corrosion proof material and preferably be nonmagnetic.

5.12 Galvanization & Nickel Plating:

- i) All ferrous parts exposed to atmosphere shall be hot dip galvanized as per latest version of IS: 2629 or equivalent International Standard as amended from time to time. Tinned copper/brass lugs shall be used for internal wiring of discharge counter. Screws used for electrical connections shall be either made of brass or nickel-plated steel.
- ii) Ground terminal pads and name plate brackets shall be hot dip galvanized.
- iii) The material shall be galvanized only after completing all shop operations.

5.13 Manufacture of Zinc Oxide (ZnO) elements:

- a) It is desired that the Manufacturer should have all modern facilities to manufacture zinc oxide discs, with special emphasis on automation of each element of processing of raw materials, mixing of ingredients employed for manufacture of discs, verification of homogeneity of powder mixture, preparation and compression of disc element and stage verification/ testing of disc elements. The Manufacturer must confirm that the process employed for the purpose is fully automatic and should describe all critical stages of manufacture, including the following:

- i) Batch Mixing
 - ii) Batch Grinding
 - iii) Batch Homogenizing
 - iv) Spray Drying
 - v) Sieving or Sizing
 - vi) Sintering
- b) The Successful Agency should also briefly describe the methods adopted and instruments used for measurements to check the quality in following areas as also other important areas during manufacturing process:
- i) The fineness of material having sub-micron size of particles.
 - ii) To measure the particle sizes of input and process materials.
 - iii) Determination of trace impurities in all the metallic oxides.
 - iv) The determination of viscosities of the metal oxide slips during powder preparation.
 - v) To determine the impurity levels of Chlorides, Nitrates and Sulphates as a spot check.
 - vi) To check the porosity and the grain sizes of pressed metal oxide elements.
 - vii) Process of testing of each disc after final finishing.

5.14 Earthing:

The Surge Arrester shall be provided with two separate earthing terminals for bolted connection to Earth flat to be provided by the Purchaser for connection to station earth-mat.

5.15 Accessories and fittings:

220kV Arresters shall be complete with insulating base having provision for bolting to flat surface of structure.

The discharge counter suitably enclosed for outdoor use shall be provided with milli ammeter for measuring the leakage current and shall not require any DC or AC Aux. Supply. The installation of discharge counter shall not affect the arrester performance.

Surge monitor consisting of discharge counters and milli ammeters should be suitable to be mounted on support structure of the arrester and should be tested for IP55 degree of protection.

All necessary accessories and earthing connection cable between the bottom of the arrester and the discharge counter shall be included in the supplier's scope.

The discharge counter shall be so designed that the readings of discharges recorded by the counter and the readings of milli ammeter (Leakage current) shall be clearly visible through an inspection window to a person standing on ground. The minimum height of support structure shall be 2.5 m.

Each Surge Counter shall have terminals of robust construction for connection to earthing lead and these shall be suitably arranged so as to enable the incoming and outgoing connection to be made with minimum bends.

The connection of Surge Arrester to Surge Monitor shall be made from bottom of surge monitor and there shall not be any opening on top of surge monitor. The connecting cable shall be 35 Sq.mm Insulated Al. cable with minimum 1.5 meters.

5.16 Name Plate:

The arresters shall be provided with non-corrosive legible nameplate indelibly marked with the following information:

- i) Order No. & Date
- ii) Manufacturer's name or trademark, type and identification no. of the arrester being supplied.
- iii) Rated voltage
- iv) Maximum continuous operating voltage
- v) Type
- vi) Rated frequency
- vii) Nominal discharge current
- viii) Long duration discharge class
- ix) Pressure relief rated current in kA rms.
- x) B.I.L. of the equipment to be protected.
- xi) Year of manufacture
- xii) Identification of the assembly positions of the unit (for multi unit arresters only).

6.0 TESTS:

6.1 TYPE TEST:

All the equipment offered, shall be fully type tested as per IEC 60099- Part 4 or IS 3070-Part 3. Copy of test reports shall be enclosed with the bid.

For any change in the design / type already type tested and the design/type offered against this bid, the Purchaser reserves the right to demand repetition of same or all type tests without any extra cost.

The Type tests shall be done at NABL approved testing laboratory.

The following type test reports shall be submitted during detailed engineering..

Tests on metal oxide blocks:

1. Steep Current Impulse Residual Voltage test
2. Lightning impulse Residual voltage test
3. Switching impulse Residual voltage test
4. Long duration current impulse withstand test
5. Operating duty test
 - i) High Current Impulse operating duty test
 - ii) Switching Surge Operating Duty test
6. P. F. voltage v/s time characteristic
7. Reference voltage test
8. Accelerated ageing test

Tests on Arrester Housing:

9. Impulse voltage withstand test on insulator
10. P.F. (Dry) voltage withstand test on insulator
11. P.F. (Wet) voltage withstand test on insulator

12. Bending test on assembly

Tests on Arrester:

- 13. Artificial pollution test
- 14. Seismic test
- 15. High current pressure relief test (High current short circuit test)
- 16. Low current pressure relief test

General:

- 17. Degree of Protection test on counter/surge monitor
- 18. Uniformity of Zinc coating
- 19. Mechanical tests
- 20. Internal partial discharge tests

6.2 ACCEPTANCE AND ROUTINE TESTS:

The manufacturer shall carry out all acceptance and routine tests as per IEC 60099- Part 4 or IS 3070-Part 3 in presence of Purchaser's representative.

Immediately after finalization of the program of type/ acceptance/ routine testing, the manufacturer shall give sufficient advance intimation to the Purchaser, to enable him to depute his representative for witnessing the tests.

Acceptance tests, whenever possible shall be conducted on the complete arrester unit. The number of samples to be subjected to acceptance tests shall be decided by the purchaser at the time of actual testing. The special thermal stability test shall be carried out as acceptance test.

The Following Acceptance tests shall be carried out in the presence of purchaser's representative.

- 1. Power frequency voltage withstand test.
- 2. Lightning Impulse residual voltage test on complete arrester / unit of arrester.
- 3. Reference voltage test.
- 4. Seal Leakage check test.
- 5. Partial discharge test.
- 6. Visual / Dimensional check.
- 7. Special thermal stability test.
- 8. Galvanization test on metal parts.
- 9. Functional (operational) tests on surge monitor/counter at nominal discharge currents
 - a) 100 Amps with 8/20 microsecond wave shape.
 - b) 10 KA with 8/20 microsecond wave shape.
- 10. Special Seal leakage test for a duration of 24 hrs, to check the water penetration, on any one randomly selected sample from every 50 (Fifty) or below nos. of LA offered for Inspection, shall be carried out and report shall be submitted.

The following Routine tests shall be done on the surge arrester.

1. Measurement of reference voltage.
2. Lightning Impulse Residual voltage test.
3. Seal Leakage check test.
4. Partial discharge test.
5. Tests on discharge counter.
6. Visual / Dimensional check.
7. Special Seal leakage test for duration of 24 hrs to check the water penetration, on any one randomly selected sample from every 50 or below Nos. of surge arrester offered for inspection, shall be carried out and report shall be submitted.

8. Test on Surge Monitors :

The Surge monitors shall also be connected in series with the test specimens during residual voltage and current Impulse withstand tests to verify efficacy of the same. Additional routine/ functional tests with one 100A and 10kA current impulse, (8/20 micro sec.) shall also be performed on the Surge monitor.

9. Test on insulators:

All routine tests shall be conducted on the hollow column insulators as per IEC - 233. The following additional tests shall be carried out on 245 kV Insulators:

- i. Ultrasonic test as a routine test.
- ii. Pressure test as a routine test.
- iii. Bending load test in 4 directions at 50% specified bending load as a routine test.
- iv. Bending load test in 4 directions at 100% specified bending load as a sample test on each lot.
- v. Burst pressure test as a sample test on each lot.

7.0 INSPECTION:

- i) The Purchaser shall have access at all times to the works and all other places of manufacturer, where the arresters are being manufactured and the Successful Agency shall provide all facilities for unrestricted inspection of the Manufacturer's works, raw materials, manufacture of all the accessories and for conducting necessary tests as detailed herein.
- ii) The successful Agency shall keep the Purchaser informed in advance of the time of starting and of the progress of manufacture of equipment in its various stages, so that arrangements could be made for inspection.
- iii) No material shall be dispatched from the point of manufacture unless the material has been satisfactorily inspected and tested.
- iv) The acceptance of any quantity of the equipment shall in no way relieve the successful Agency of his responsibility for meeting all the requirement of this specification and shall not prevent subsequent rejection if such equipment are later found to be defective.

8.0 QUALITY ASSURANCE PLAN & STAGE INSPECTION:

The bidder shall ensure that for the purpose of supply of equipments, the manufacturer will have to follow strict quality assurance program, which will include thorough verification of samples of critical assemblies and accessories, verification of sources of raw materials, detailed verification of drawing & design, checking up of relevant calculations, stage inspections at various critical stages of manufacture and minor modifications consequent to such stage inspections as per our requirements and all other

related requirements, which have generally been brought out in bidding documents and the detailed contract. It is expected that bidder would be very serious and prudent in meeting these requirements without any loss of time, so that supply of equipments in line with quality assurance program is ensured within targeted schedule.

Purchaser reserves the right to specify various stages for stage inspections and also for manufacture of a proto type unit for inspection & testing, before according clearance for bulk manufacturing. The bidder shall ensure that they are following a proper quality assurance program for manufacture of offered equipments.

The Successful Agency shall ensure that manufacturer invariably furnish following information:-

- i) Statement giving list of important raw materials, names of sub supplier for the raw material, list of standards according to which the raw material are tested, list of tests normally carried out on raw material in presence of manufacturer's representative, copies of test certificates.
- ii) Information and copies of test certificates as in (i) above in respect of bought out items.
- iii) List of manufacturing facilities available.
- iv) Levels of automation achieved and list of areas where manual processing exists.
- v) List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspection.
- vi) Special features provided in the equipment to make it maintenance free.
- vii) List of testing equipment available with the manufacturer for final testing of equipment specified and test plant limitations, if any deviation about type, special, acceptance and routine tests specified in the relevant Indian Standards or equivalent international standard. These limitations shall be very clearly brought out in schedule of deviations from specified test equipments.

The successful Agency shall arrange the following information to Purchaser within 30 days of award of Contract.

- i) Quality Assurance Plan (QAP) withhold points for purchaser's inspection.
- ii) The quality assurance plans and holds points shall be discussed between purchaser and Successful Agency before the QAP is finalized.
- iii) The successful Agency shall also ensure that the manufacturer submits the routine test certificates of bought out items and for raw material at the time of routine testing of the fully assembled equipment.

9.0 LIST OF DRAWINGS AND DOCUMENTS:

The Successful Agency shall furnish four sets of following details and drawings during detailed engineering;

- 1) General outline drawings of complete Surge Arrester with technical parameters.
- 2) Drawings showing clearance from grounded and other live objects and between adjacent poles of Surge Arresters required at various heights of Surge arresters.
- 3) Drawing showing details of pressure relief device.
- 4) Sectional view to explain pressure relief arrangement.
- 5) Detailed drawing of discharge counters along with the wiring and schematic drawing of discharge counters & meters.
- 6) Details of grading rings if used.
- 7) Outline drawing of insulating base.
- 8) Mounting details of Surge arresters.
- 9) Details of the line terminal connector and ground terminals.

- 10) Details and dimensions of ZnO blocks.
- 11) Volt time characteristics of Surge Arresters.
- 12) Details of galvanizing being provided on different ferrous parts.
- 13) The detailed dimensional drawing of porcelain housing such as ID, OD, thickness and insulator details such as height, profile of petticoats, angle of inclination & gap between successive petticoats, total creepage distance etc.
- 14) Name plate drawing.
- 15) Sectional view of sealing arrangement and pressure relief device.
- 16) Type test reports in case the equipment has already been type tested.
- 17) Test reports, literature, pamphlets of the bought out item and raw material.

The Successful Agency shall submit four sets of final version of all the above drawings for purchaser's approval within two weeks of placement of order. The purchaser shall communicate his comments/approval on the drawings to the Successful Agency within reasonable time. The Successful Agency shall, if necessary, modify the drawings and resubmit four copies of the modified drawings for Purchaser's approval within two weeks from the date of Purchaser's comments. After receipt of Purchaser's approval, the Bidder shall within three weeks submit four prints.

The Successful Agency before commencement of supply shall submit two set of the type test reports, duly approved by the purchaser. Two copies of acceptance and routine tests certificates, duly approved by the purchaser shall accompany each dispatched consignment.

The manufacturing of the equipment shall be strictly in accordance with the approved drawings and no deviation shall be permitted without the written approval of the purchaser. All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawing shall be at the Bidder's risk.

Two copies of printed and bound volumes of operation, maintenance and erection manuals in English Language, for each type and rating of equipment supplied shall be submitted. The manual shall contain all the drawings and information required for erection, operation and maintenance of the equipments. The manual shall also contain a set of all the approved drawings.

Approval of drawings/work by purchaser shall not relieve the Successful Agency of his responsibility and liability for ensuring correctness and correct interpretation of the latest revision of applicable standards, rules and codes of practices. The equipment shall conform in all respects to high standards of engineering, design, workmanship and latest revisions of relevant standards at the time of ordering and Purchaser shall have the power to reject any work or material, which in his judgment is not in full accordance therewith.

10.0 PACKING & FORWARDING:

Successful Agency shall ensure that the equipment shall be packed in crates suitable for vertical/horizontal transport, as the case may be and suitable to withstand handling during transport and outdoor storage during transit. The easily damageable material shall be carefully packed and marked with the appropriate caution symbols. Wherever necessary, proper arrangement for lifting such as lifting hooks etc. shall be provided. Any material found short inside the packing cases shall be supplied by supplier without any extra cost.

Components containing glass shall be carefully covered with shock absorbing protective material such as Thermocole. All opening in the equipment shall be tightly covered, plugged or capped to prevent dust

and foreign material from entering in. All spares parts shall be packed and crated for long storage conditions at site.

Each Consignment shall be accompanied by a detailed packing list containing the following information:

- a) Name of the consignee
- b) Details of consignment
- c) Destination
- d) Total weight of consignment
- e) Sign showing upper/ lower side of the crate
- f) Handling and unpacking constructions
- g) Bill of materials indicating contents of each package.

The supplier may ensure that the packing list and the bill of materials are approved by purchaser before dispatch.

The material shall be transported within India to the respective destination by Road transport/Rail transport as the case may be at option of purchaser.

ANNEXURE- I
GUARANTEED TECHNICAL PARTICULARS

S.No	Description	Particulars
		220kV
1.	Name of Manufacturer	
2.	Arrester type (with Manufacturer type designation)	
3.	Applicable Standards	
4.	Rated Arrester Voltage of complete unit (kV)	
5.	Rated system voltage(kV)	
6.	Max continuous operating voltage (MCOV) kVrms	
7.	Nominal Discharge Current with 8/20 μ s (kA)	
8.	Leakage current at COV (mA)	
9.	Long Duration Discharge Class	
10.	Minimum energy discharge capability (kJ/kV)	
11.	Maximum switching current impulse residual voltage (kVp) at	
	i) 1000 A	
	ii) 250 A	
12.	Maximum residual voltage with 8/20 μ s wave (kVp)	
	i) 5 kA	
	ii) 10 kA	
	iii) 20 kA	
13.	Safe fault current (kA)	
14.	Steep current Impulse residual voltage test with 1 μ s front time current wave of 10kA peak	
15.	Pressure relief class	

16.	Lightning impulse withstand voltage of arrester housing with 1.2/50 μ s wave (kVp)	
17.	One minute power frequency withstand voltage of housing (dry /wet) (kVrms)	
18.	Maximum RIV at continuous operating voltage (μ V)	
19.	High current short duration impulse withstand level with 4/10 μ s wave (kAp)	
20.	Over voltage withstand capability (kVp)	
	i) 10 seconds	
	ii) 1 seconds	
	iii) 0.1 seconds	
21.	a) Reference voltage	
	b) Reference current	
22.	Number of units per phase and rating of each unit	
23.	Minimum total creepage distance (mm)	
24.	Total weight of arrester	
25.	Maximum cantilever strength of Lightning arrester (Including wind load)	
26.	Overall height of Surge Arrester (mm)	
27.	Cantilever strength of assembled arrester	
28.	Minimum distance between arrester phase legs (mm)	
29.	Maximum Distance recommended from equipment to be protected by surge arrester (mm)	
30.	Minimum Distance between Grounded object (mm)	
31.	Details of Metal Oxide block	
32.	Material	
33.	Diameter (mm)	

34.	Height (mm)	
35.	Surge monitor	
	a) Make	
	b) Model	
	c) Type	
	d) Sensitivity of surge counter	
	e) Nominal discharge current	
	f) Maximum current to be withstood by the surge monitor	
	g) Counter operation	
	h) Safe leakage current indication	
	i) Leakage current indication for surge arrester deterioration	
	j) Net weight	

PART-10
33KV OUTDOOR
VACCUM CIRCUIT BREAKER

TECHNICAL SPECIFICATION OF 33kV VACUUM CIRCUIT BREAKER

1.0 SCOPE

This specification covers design, engineering, manufacture, assembly, routine testing inspection and testing before supply, packing, forwarding, delivery and supervision of erection & testing at site of 33kV, 3phase, vacuum circuit breakers along with, mounting, structures, all the accessories and auxiliary equipment and mandatory spares and maintenance equipment herein required for their satisfactory operation in 220/33kV substation for “ M/S. TALCHER FERTILIZERS Ltd. ”

It is not the intent to specify completely here all the details of design and construction of the circuit breakers. However, the breakers shall conform in all respects to the high standard of engineering design and workmanship and shall be capable of performing in continuous commercial operation in a manner acceptable to the Purchaser. The circuit breakers offered shall be complete with all components necessary for their effective and trouble free operation.

1.1 SITE INFORMATION

The circuit breaker to be supplied against this specification shall be suitable for satisfactory continuous operation under the following Topographical and Meteorological conditions:-

a)	Location	Outdoor
b)	Maximum ambient air temperature (°C)	50
c)	Minimum ambient air temperature (°C)	5
d)	Average daily ambient air temperature (°C)	32
e)	Relative humidity (%)	100%
f)	Maximum altitude above mean sea level (m)	<1000
g)	Basic wind speed (m/s)	50
h)	Isokeraunic level (days/year)	70
i)	Seismic level	Zone III as per IS 1893
j)	Degree of Pollution (mm/kv)	31
k)	Site location	Angul. State of ODISHA

2.0 STANDARDS

2.1 Bidders may please note that 33kV circuit breaker shall be manufactured, tested and supplied for all guaranteed technical particulars generally conforming to meet the requirement of this technical specification and relevant national standards of India or international electro technical commission standards with latest amendments of relevant standards rules and codes.

Sl.No	Indian standard	Title	International standard
1		High-Voltage Switch gear and Control gear- Common Specifications	IEC 62271-1
2		High-Voltage Alternating-Current Circuit Breakers	IEC 62271-100
3	IS 13947	Specification for Low -Voltage Switchgear and Control gear	
4		Low -Voltage Switchgear and Control gear	IEC 60947
5	IS 2099	Specification for Bushings of Alternating voltages above 1000V	IEC 60137
6	IS 2629	Recommended practice for Hot-Dip Galvanizing of Iron and Steel	
7	IS 375	Marking and arrangement for switchgear bus-bar, main connections and auxiliary wirings	
8	IS 2147	Degree of Protection provided for Low voltage Switchgear & Control gear	
9	IS 5561	Specification for Electric Power Connectors	
10	IS 5	Colour for Ready Mix Paints	
11	IS 996	A.C Motors	IEC 60034
12		Pressurised Hollow Column Insulators	IEC 61264
13	IS-2486	Specifications for clamp connectors	
14	IS-2062/2016	Specification for GI / SS nut, bolt, washer	
15		Indian Electricity Rules 1956	

- 2.2 If the equipment offered by Bidders conforms to any other standards, salient points of comparison between the standards adopted and the specific standards shall be clearly brought out in relevant schedule of technical deviation. It will be sole responsibility of Bidders to prove that the salient features of offered equipment are equivalent or better than IS.
- 2.3 The bidder shall also note that list of standards presented in this specification is not complete. Wherever necessary the list of standards shall be considered in conjunction with specific IS/IEC.
- 2.4 When the specific requirements stipulated in the specifications exceed or differ than those required by the applicable standards, the stipulation of the specification shall take precedence.
- 2.5 The equipment conforming to standards other than specified above shall be subject to purchaser approval.

3.0 GENERAL TECHNICAL REQUIREMENTS OF VACUUM CIRCUIT BREAKERS

- 3.1 Exposed live parts shall be placed high enough above ground to meet the requirement of local safety codes.

- 3.2 Any part of the breaker, especially the removable ones, shall be freely interchangeable without the necessity of any modification at site.
- 3.3 Complete circuit breaker with all the necessary items for successful operation shall be supplied.
- 3.4 Current density adopted for the design of the terminal pads shall in no case exceed the following values
- i. For copper pads - 1.6 Amp/sq.mm.
 - ii. For others- 1.0 Amp/sq.mm.
- 3.5 Provisions shall be made for attaching operation analyzer after installation at site to record contact travel & speed and for making measurement of operation timings, synchronization of contacts of all poles.

4.0 DUTY REQUIREMENT:

- 4.1 Circuit breakers shall be totally re-strike free under all duty conditions and shall be capable of performing specified duties.
- 4.2 Circuit breakers shall meet the duty requirements for all type of phase to phase and ground fault, irrespective of fault location. Breakers shall also meet idle line charging and dropping when used on an effectively grounded system and perform make and break operations as per stipulated duty cycles satisfactorily.
- 4.3 Circuit breakers shall be capable of following duty requirement as mentioned in Annexure-1
- a. Interrupting the steady and transient magnetizing inrush current of power transformer.
 - b. Interrupting line charging current.
 - c. Clearing short line faults (kilometric faults) with source impedance behind the bus equivalent to symmetrical fault current specified.
 - d. Breaking inductive currents of up to 10 Amp.
 - e. Out of phase breaking capacity.
- 4.4 Breakers shall satisfactorily withstand high stresses imposed during fault clearing, load rejection and re-energisation of lines with trapped charges. Breakers shall also withstand the voltage specified in Annexure-1.

5.0 CONTACTS:

- 5.1 Main contacts shall have ample area and contact pressure for carrying rated current continuously and also withstand the short time rated current of Breakers without excessive temperature rise, which may cause their pitting or welding. Contacts shall be adjustable to allow for wear, easily replaceable and shall have a minimum of moveable parts and adjustments to accomplish desired results.
- 5.2 All external and internal make and break contacts shall be sealed and shall be free from atmospheric effects. Contacts shall be designed to have adequate thermal and current carrying capacity for the duty specified and to have long life expectancy so that frequent replacement due to excessive burning is minimized. Provision shall be made for rapid dissipation of heat generated by the arc on opening.
- 5.3 Main contacts shall be first to open and last to close to minimize contact burning and wear.
- 5.4 Breakers shall be so designed that when operated within their specified rating, temperature of each part will be limited to values consistent with a long life of the material used. The temperature rise above maximum ambient temperature shall be as per IEC 62271-1.

6.0 PORCELAIN HOUSING:

- 6.1 Porcelain housing shall be of single piece construction without any joint or coupling. It shall be homogeneous, free from lamination, cavities and other flaws or imperfections that might affect high mechanical and dielectric strength and shall be thoroughly vitrified tough and impervious to moisture.
- 6.2 Glazing of porcelain shall be uniform, brown or dark brown coloured, free from blisters, burns and similar other defects with a smooth surface arranged to shed away rainwater or condensed water particles (fog).
- 6.3 Housing shall be designed to have ample insulation, mechanical strength and rigidity for satisfactory operation for the conditions under which they will be used. All housing of identical ratings shall be interchangeable.
- 6.4 Puncture strength of housing shall be greater than the dry flashover value. When operating at normal rated voltage there shall be no electric discharge between the conductors and housing which would cause corrosion or injury to conductors, insulators or supports by the formation of substance produced by electro-chemical action. These housing when operating at the normal rated voltage shall cause no radio interference/disturbance.
- 6.5 All iron parts shall be hot dip galvanised and all joints shall be airtight. Surfaces of the joint shall be trued-up by grinding porcelain parts and by machining metal parts. Housing design shall be such as to ensure a uniform compressive pressure on the joints.
- 6.6 Interrupter housing insulator and support insulator shall satisfactorily withstand insulation level of circuit breaker specified in Annexure-1 and shall also be suitable for contaminated and polluted atmosphere as per relevant standard.

7.0 AUXILIARY CONTACTS:

- 7.1 Auxiliary switches (contacts) required for satisfactory operation of Circuit breaker including automatic reclosing, ON/OFF indicators both in control room and cubicle switchyard, semaphore indicators in the mimic diagram in the control room and anti pumping feature shall be provided on each circuit breaker. All these auxiliary switches and required relays with their scheme shall be included in the scope of supply.
- 7.2 In addition to the auxiliary switches mentioned above, Bidders shall provide as spares ten auxiliary contacts each of the "normally-open" and "normally-closed" types which shall operate with the closing or opening of the circuit breakers. These spare contacts shall be utilized for additional safety inter-locking and other monitoring devices by the purchaser.
- 7.3 All auxiliary contacts shall be placed in a weatherproof casing. Provision shall be available to convert these spare "normally-open" contacts to "normally-closed" type and vice versa.
- 7.4 Auxiliary switch of Breakers shall be preferably driven by breaker operating rod. However in case due to some constraint same is not possible then a plug-in device shall be provided to simulate the opening and closing operations of circuit breaker for the purpose of testing control circuits.
- 7.5 Arrangement proposed for connecting control cables to the auxiliary switches shall be clearly stated. Provision shall be made for suitable cable glands fitted on gland plate for receiving control cables required for inter connecting assemblies and the auxiliary switches of the breaker. Additional Gland plates shall be supplied duly drilled and fitted with cable glands. Gland plate and operating mechanism doors shall be provided with gasket properly. These cable glands shall be suitable for armoured copper control cables. The cable glands with suitable blanking arrangement shall be fitted on the gland plate that shall be fastened suitably at the bottom of each control cabinet for connecting copper control cables provided by the purchaser.

7.6 1.1 KV grade armoured copper control cables shall be used by the purchaser and therefore, the offered cable glands shall be suitable for the sizes of these cables.

7.7 The position of rotating Aux. switches in mechanism box should be such that there should not be any difficulty in cable connection and tracing particular terminal. All terminals marking should be clearly visible from front/outside the switch.

8.0 TOTAL BREAK TIME:

8.1 "Total Break Time" as specified in Annexure-1, shall not exceed under any circumstances for the following duties:

- a. Test duties (with TRV) as per IEC-62271-100
- b. Short line fault L75 (with TRV) as per IEC-62271-100

8.2 Bidders may please note that specified break time of Breakers shall not exceed under any duty conditions, variation of the trip coil voltage, spring charged etc.

9.0 OPERATING MECHANISM AND ASSOCIATED EQUIPMENTS:

9.1 GENERAL REQUIREMENTS:

1. Each circuit breaker shall be designed for remote control operations from the control room. In addition, there shall be provision for local tripping & closing operations both by electrical & mechanical control. Mechanical arrangement should be provided to facilitate manual tripping of circuit breaker for emergency trip under emergency conditions.
2. Operating mechanism shall be of spring type only. Mechanism shall be adequately designed & capable of performing satisfactorily all specified tripping and reclosing duty within the specified time. Entire operating mechanism, control circuitry including electrical controls & monitoring devices and all other accessories, as required, shall be housed in an outdoor type, hot dip galvanised steel enclosure.
3. This enclosure shall conform to the degree of protection IP-55 of latest version of IS: 2147. The enclosure shall be invariably mounted on a separate concrete plinth of 300 mm height. However, in case due to IP-55 a protection limitation, if operating mechanism is mounted below the pole housing. in that case it should be possible for the operating personnel to manually charge closing spring / mechanism from ground level including ON/OFF operation without using any stool or otherwise. However due to any reason if operating platform is absolutely necessary, the same shall be deemed to be included in scope of supply.
4. All working parts in the mechanism shall be made of corrosion resistant material. All bearings which require greasing shall be equipped with pressure grease fittings. Bearing pins, bolts, nuts and other parts shall be adequately pinned or blocked to prevent loosening or changing of adjustment with repeated operation of the breaker.
5. Design of the operating mechanism shall be such that it shall be practically maintenance free. Guaranteed years of maintenance free operation, the number of full load and full rated short circuit current breaking/operation without requiring any Maintenance or overhauling shall be clearly stated in the Bid. As far as possible the need for lubricating the operating mechanism shall be kept to the minimum and eliminated altogether, if possible
6. The operating mechanism shall be non-pumping and trip free electrically and mechanically. A latch checking switch shall be provided on mechanically trip free mechanism to prevent reclosing before Breakers latches have reset. There shall be no objectionable rebounds in the mechanism and it shall not require

any critical adjustments at site. It shall be rigid, positive and fast in operation. Mechanism shall be such that the failure of any auxiliary spring shall not cause false tripping or closing. Operation of the power operated closing device, when Circuit breaker is already closed, shall not cause damage to Circuit breaker or endanger the operator's life. Provision shall be made for attaching an operation analyzer to facilitate speed test after installation of Breakers at site. ON-OFF indicating lamps shall be provided on the mechanism box.

7. A mechanical indicator shall be provided to show "open" and "close" position of Breakers in addition to facilitate for remote electrical indication. An operation counter shall also be provided in the central control cabinet. Mechanical indicator and operation counter shall be located in a position where it shall be visible to a man standing on the ground level with the mechanism housing closed.
8. Circuit breaker operating mechanism shall incorporate an electrically achieved positive acting anti-pumping feature to prevent Circuit breaker from reclosing after an automatic opening when the initiating closing device is maintained in the position for closing. Necessary anti-pumping relay shall be included in the scope of supply.
9. All material for making connection between Circuit breaker and its control cubicle shall be included in the scope of supply.
10. All the similar contacts of 3pole circuit breaker shall be designed to touch or open essentially simultaneously & in any case shall close or open within a period of half a cycle or less. Auxiliary circuit through resistors shall be closed in sufficient time before the main contacts closes to ensure that the over-voltage will be held to guarantee value under most favourable sequence of contact closing.
11. The parts of the CBs like operating mechanism, links, operating arm etc. should not be exposed to atmosphere. It means various parts of CBs should be properly covered and should be tested for IP 55 or equivalent test.

9.2 MOTOR OPERATED SPRING CHARGING MECHANISM:

1. Spring operated mechanism shall be complete with motor, opening & closing spring with visual indication for spring charged / discharged condition and all necessary accessories to make the mechanism a complete operating unit. Each mechanism shall be so designed as to enable a continuous sequence of "opening" and "closing" operations to be obtained as long as power is available to the motor and at least one "Opening" and "closing" operation after failure of power supply to the motor. Breaker operation shall be independent of the motor which shall be used solely for the purpose of compressing the closing spring. Motor rating shall be such that it requires only about 30 seconds for charging the closing spring fully. Closing action of Circuit breaker shall compress the opening spring ready for tripping. Spring charging motor shall be AC motor. Mechanism shall be capable of performing the rated operating duty cycle.
2. For Manual spring charging operation through operating handle it is desired that mechanism box may be mounted at adequate height and gear ratio shall be so chosen that a person standing at ground level is able to manually charge the spring without much effort. The handle shall be either at normal operable height or otherwise a suitable 3ft x 3ft platform nearly 4ft below the manual operating handle with foldable ladder shall be provided to facilitate manual charging of spring. The operating handle for charging the spring shall be inserted from side of mechanism box and not from bottom. The spring charging facility shall have ease of operation and the movement of handle shall be in vertical plane only.
3. The mechanism shall be strong, rigid positive and fast in operation. Provision shall be made for local electrical control and local / remote selection with enough contacts in the cubicle of the breaker. Manual emergency local tripping arrangement shall be provided on the breaker for use in emergency during maintenance.

9.3 MOTOR:

1. Motors shall be of self ventilated type having TEFC (totally enclosed fan cooled) enclosure.
2. Depending upon the capacity and loading conditions supplier shall design suitable grease lubricated or oil lubricated bearings for above motors. Bearing shall be so constructed that the loss of grease and its creeping along with shaft into motor housing is prevented. It shall also prevent dirt and water from getting into the motor.
3. Continuous motor rating (name plate rating) shall be at least ten (10) percent above the maximum load demand of the driven equipment at design duty point & the motor shall not be overloaded at any operating point of driven equipment that will arise in service.
4. Motors shall be capable of giving rated output without reduction in expected life span when operated continuously in the system having the particulars as given in principle parameters.
5. The motors shall be suitable for full voltage direct-on-line starting. These shall be capable of starting and accelerating to the rated speed along with the driven equipment without exceeding the acceptable winding temperature even when the supply voltage drops down to 75% of the rated voltage.

10.0 CONTROL:

- 10.1 The close and trip circuits shall be designed to permit use of momentary contact switches and push buttons. The control circuit shall include the following features
 - i. Two electrically independent trip circuits including two trip coils per mechanism and one closing coil per mechanism for 33KV breakers
 - ii. The breaker shall normally be operated by remote electrical control. Electrical tripping shall be performed by shunt trip coils. However, provision shall be made for local electrical control. For this purpose local / remote selector's switch and close and trip push buttons shall be provided in the breaker central control cabinet. Remote located control switches and indicating lamps shall be provided in the control panel by the purchaser.
 - iii. Conveniently located manual emergency trip.
 - iv. Pole discrepancy feature to trip closed poles in the event of pole discrepancy. While opening and / or closing, all the three poles shall operate simultaneously.
 - v. Anti-pumping feature.
 - vi. Auxiliary switches as specified elsewhere.
 - vii. Independence of trip circuit from local remote selection.
 - viii. Alarms, indications, monitoring equipments and interlocks as specified elsewhere.
 - ix. Trip circuit supervision for pre-trip as well as post-trip.
- 10.2 Closing coil shall operate correctly at all values of D.C voltage between 85% and 110% of the rated control voltage and shunt trip coil shall operate correctly under all operating conditions of the circuit breaker, up to the rated breaking capacity of the circuit breaker and at all values of D.C. control voltage between 70-110% of rated voltage.
- 10.3 A separate cabinet shall be provided for housing operating mechanism and control circuitry.
- 10.4 The tenderer shall furnish along with the bid, detailed schematic drawings showing all types of control, protection, monitoring schemes to be employed by the tenderer. The successful tenderer shall be required to modify the schemes, if necessary, after discussions with the purchaser.

10.5 AUXILIARY SWITCHES:

Each operating mechanism of the circuit breaker shall be provided with Cam / Snap type auxiliary switches with ten (10) normally open and ten (10) normally closed contacts (i.e., 10 NO + 10 NC) contacts for each pole, for 33KV breakers rating, exclusively for the purchaser's use with continuous current rating of 16A DC. Breaking capacity of the contacts shall be minimum 5A with circuit time constant less than 20 milliseconds at the rated DC voltage. Normal position of auxiliary switches refers to contact position when circuit breaker is open. There shall be provision to add more auxiliary switches at a later date if required. Additional contacts required for pole discrepancy relay etc., should be provided separately.

- 10.6 Breakers shall normally be operated by remote electrical control. Electrical tripping shall be performed by shunt trip coils. However, provisions shall also be made for local electrical control. For this purpose, a local/remote selector switch and trip/neutral/close switch shall be provided in Breakers central control cabinet.

11.0 **ALARMS AND INDICATIONS:**

Potential free contacts shall be provided, duly wired up to the operating mechanism housing/ control cabinet for the following alarms and indications for purchaser use (Control & Automation).

Alarms:

1. Pole discrepancy
2. Auxiliary AC / DC supply failure

Indication:

1. Breaker on / off
2. Spring charged

Mechanical Indication:

The operating mechanism housing shall be provided with the following mechanical indication / counters

1. Breaker on / off.
2. Operation counters to register the number of breaker operations.

12.0 **SURFACE FINISH PAINTING & GALVANISING:**

- 12.1 All interiors and exteriors of tanks, mechanism, enclosures, cabinets and other metal parts shall be thoroughly cleaned to remove all rust, scales, corrosion, greases or other adhering foreign matter. All steel surfaces in contact with insulating oil, as far as accessible shall be painted with not less than two coats of heat resistant, oil insoluble, insulating paint.
- 12.2 All ferrous metal surfaces exposed to atmosphere shall be given two primer coats of zinc chromate and two coats of epoxy paint with epoxy base thinner or hot dip galvanized or two packs of aliphatic polyurethane finished paint.
- 12.3 All metal parts not accessible for painting shall be made of corrosion resistant material. All machine finished or bright surfaces shall be coated with a suitable preventive compound and suitably wrapped or otherwise protected. All paints shall be carefully selected to withstand tropical heat and extremes of weather within the

limits specified. Paint shall not scale off or wrinkle or be removed by abrasion due to normal handling.

- 12.4 All external paintings shall be shade No. 697 of IS-5 subject to specific approval of purchaser. All ferrous parts & steel structure including all sizes of nuts, bolts, plain and spring washers, support channels, structures, etc. shall be hot dip galvanized or stainless steel or electro-galvanized.

13.0 EARTHING:

The operating mechanism housing, control cabinets, live tanks, support structure etc. shall be provided with two separate earthing terminals suitable for bolted connection to ground mat riser shall be provided.

14.0 NAME AND RATING PLATES:

- 14.1 The name plate shall be of Anodized Aluminium plate with minimum thickness of 2mm. And it shall be etched by photo printing with silver background. The text size shall be minimum 4mm.

- 14.2 The method of printing of letters on the Rating & Diagram plate shall be such that inscriptions shall not fade by ultra violet rays and other adverse weather conditions under which the same is subject to during service life of equipment.

- 14.3 The rating plate shall be about 1000-1300 mm above ground level so that it is visible in position of normal device and installation.

- 14.4 The CB shall be provided with non-corrosive legible nameplate indelibly marked with the following information as per latest version of IEC 62271-100. This rating plate shall also contain Customer name, Purchase order number and date.

- 1) Manufacturer's name & trade mark.
- 2) Serial number or type designation making it possible to get all the relevant Information from the manufacturer.
- 3) Year of manufacture.
- 4) Rated nominal/highest voltage.
- 5) Rated insulation level.
- 6) Rated frequency.
- 7) Rated normal current.
- 8) Rated capacitive/inductive breaking current.
- 9) Rated short circuit breaking current.
- 10) First pole to clear factor.
- 11) Rated duration of short circuit current.
- 12) Rated out of phase breaking current.
- 13) Rated auxiliary d.c supply voltage of closing and opening devices.
- 14) Rated pressure of compressed air / gas for operation and interruption.
- 15) Rated AC supply voltage of auxiliary circuits
- 16) Mass of circuit breaker.

- 17) Purchase's order no. & date

15.0 FITTINGS AND ACCESSORIES:

Following is the list of the major fittings and accessories to be included by manufacturer as an integral part of equipment.

- 1) Hollow insulator columns for poles of Circuit Breaker
- 2) Operating mechanism housing complete with
- 3) Pistol grip circuit breaker control switch having trip / normal/ close position.
- 4) Trip coils/ closing coil
- 5) Space heater equipped with industrial grade switch
- 6) Cable glands
- 7) Industrial grade receptacle type 3 pin 15 Amps power plug & socket with switch
- 8) Local/remote changeover switch.
- 9) Manually operated tripping push button/lever (mechanical device convenient located to trip all three phases simultaneously).
- 10) Padlocks and duplicating keys
- 11) Terminal Boards.
- 12) Spring charged discharged indicator.
- 13) Operation counter.
- 14) Facility for manual charging of spring.
- 15) Fuses/MCBs as required for AC & DC Supply
- 16) The number of terminals provided shall be adequate enough to wire out all contacts and control circuits plus 20% spare terminals for owner's use.
- 17) Auxiliary switch
- 18) Mechanical ON & OFF Indicator.
- 19) Cubicle lamp with cage & switch.
- 20) Name & Rating plate in accordance with IEC 62271-1 Incorporating year of manufacture.
- 21) Pressure Gauge for N₂ Pressure.

16.0 FOUNDATION & SUPPORT STRUCTURES FOR BREAKER STRUCTURES:

16.1 SUPPORT STRUCTURE:

Support structures along with the foundation bolts required for mounting the breaker shall be within the scope of the bidder and prices for the same shall be quoted inclusive of all the items of structures, hardware and accessories for mounting so as to put circuit breaker in to service. The support structures for circuit breakers shall be designed to maintain minimum ground clearance from the lowest live terminal to breaker structure base plate (to be fixed on concrete plinth) as per Annexure-1.

16.2 FOUNDATION:

Bidders shall furnish a drawing showing foundation plan for breakers offered by them clearly indicating the following

- i. Dynamic upward and downward loads for which it is designed
- ii. Static load
- iii. Total weight of breaker considered for foundation design
- iv. All spacing and dimensional details along with details of foundation bolts.

17.0 ESSENTIAL SPARE ITEMS:

The bidder may please note that the name of essential items required for operation & maintenance of circuit breakers shall be included while offering the prices for circuit breakers covered under the package.

18.0 TYPE TESTS & TEST REPORTS

- 18.1 All the equipment offered, shall be fully type tested as per IEC 62271-100. In case the equipment of the type and design, offered, has already been type tested, Supplier shall furnish the type test reports along with the Bid.
- 18.2 For any change in the design / type already type tested and the design/type offered against this Bid the purchaser reserves the right to demand repetition of tests without any extra cost on the first or any one unit of any rating included in the Bid.
- 18.3 In case the equipment has not been type tested earlier, all the type tests as per relevant standards shall be carried out by the Supplier in the presence of purchaser’s representative without any extra cost.
- 18.4 The test reports submitted with the offer shall as per applicable CEA Guidelines for various tests as indicated below. The tests should have been carried out in an independent NABL approved laboratory.
- 18.5 All routine tests as per IEC: 62271-100 (2001) shall be conducted in the presence of purchaser’s representative unless waived off and their reports shall be submitted and got approved by the purchaser prior to dispatch of the equipment.
- 18.6 Reports for routine tests in respect of associated equipment eg: compressor, air receiver, meters, instruments, pressure switches, relays, piping etc. as per the latest edition of relevant IS or IEC publication or any equivalent authoritative standard shall be supplied by the purchaser prior to dispatch of the equipment.

19.0 TYPE TESTS:

- 19.1 Circuit Breakers should be suitable to close and open successfully for specified idle line charging current without developing dangerous over voltages. Test certificates shall clearly indicate the type and model number etc., so that relevant details of offered circuit breakers could be verified. While submitting offers the model and type etc., shall be clearly indicated. Suppliers have to submit one complete set of Type Test reports for the offered circuit breakers for the following tests

S.NO.	TYPE TESTS REPORTS TO BE FURNISHED BY BIDDERS
1	Dielectric tests(Dielectric properties should be tested with the closing resistor)
	a) Lighting impulse voltage withstand test
	b) Power frequency voltage withstand test
2	Measurement of resistance of the main circuit
3	Temperature rise test

4	Short time withstand current and peak withstand current test
5	Tightness test
6	Mechanical Operation Test (Mechanical endurance test)
7	Short circuit making and breaking capacity test
8	Capacitor current switching test
9	Verification of the degree of protection
10	Extended mechanical endurance tests on circuit breakers for special service
11	Humidity test
12	Critical Current Test
13	Short line fault test
14	Out of phase making and breaking test
15	Electrical endurance test
16	Single phase and double earth fault test
17	Capacitive current switching test
18	Evolving Fault Test
19	Seismic withstand test:
20	Shunt reactor current-switching test
21	X-radiation test for Vacuum interrupter.

- 19.2 Seismic withstand test on the complete equipment shall be carried out along with the supporting structure etc. Seismic level specified shall be applied at the base of the Structure. The accelerometers shall be provided at the terminal pad of the equipment. Seismic test shall be carried out in all possible combination of the equipments.
- 19.3 Supplier shall indicate the standard routine tests. Supplier shall completely assemble and test each breaker to ensure satisfactory working of all components and also assembled breakers as a whole.
- 19.4 All acceptance and routine tests as stipulated in the IEC 62271-100 standard shall be carried out by the supplier in the presence of purchaser's representative.
- 19.5 Speed curves for each breaker shall be obtained with the help of a suitable operational analyzer to determine Breaker contact movement during opening, closing, auto- reclosing and trip free operation under normal as well as limiting operating conditions. Tests shall show the speed of contacts directly at various stages of operation, travel of contacts, opening time, closing time, shortest time between separation and meeting of contacts at break/make operation etc. This test shall also be performed at site for which the necessary operation analyzer along with necessary transducers, cables, console, etc. shall be provided if required.
- 19.6 Preliminary copy of the test results shall be supplied for approval before dispatch / shipment of Circuit breakers. Four copies of complete test results shall be furnished with Circuit breakers. These shall include complete reports and results of the routine test and type tests carried out on circuit breakers of identical design.

20.0 ADDITIONAL TESTS:

Purchaser reserves the right for carrying out any other tests of a reasonable nature at the works of the supplier / laboratory or at any other recognized laboratory / research institute in addition to the above mentioned type, acceptance and routine tests at the cost of the purchaser to satisfy that the material complies with the intent of this bid. Supplier may please note that Insulation Resistance test by 5kV or 10kV Megger at manufacturer's works shall be invariably carried out on each circuit breaker to record following IR values.

- a. Insulation resistance between top terminal to earth (for open and closed condition of circuit breaker) in --- Mega Ohms.
- b. Insulation resistance between both Terminals in open and close condition of circuit breaker in --- Mega Ohms.

21.0 INSPECTION:

- 21.1 Purchaser shall have access at all times to the works and all other places of manufacture and the Supplier shall provide all facilities for unrestricted inspection of the manufacturer's works, raw materials, manufacture of all the accessories and for conducting necessary tests as detailed herein. Purchaser reserves the right to insist for witnessing the acceptance/routine testing of the bought out items. Supplier shall submit the routine test certificates of bought out items and raw material, at the time of routine testing of the fully assembled breaker.
- 21.2 No material shall be dispatched from its point of manufacture unless the material has been satisfactorily inspected and tested. The Supplier shall within 30 days of placement of order, submit the list of bought out accessories and the names of sub- suppliers.
- 21.3 Supplier shall indicate the inspections and checks carried out at various stages of the manufacture of Circuit Breaker. Complete record of stage inspection would be kept by the supplier and this record should be made available for inspection by the representative of the Purchaser. The supplier should indicate the manufacturing programme and the Purchaser will have a right to depute inspecting officers during the manufacture of the equipment. Purchaser reserves the right to carry out stage Inspections at all stages, for which advance intimation shall be given and all necessary cooperation shall be rendered by the manufacturer.
- 21.4 At the time of inspection, the supplier shall identify each and every item / accessories of the particular Circuit Breaker under testing. Unless all the items are identified, the manufacture will not be treated as complete. Various tests stipulated in IEC 62271-100 shall be performed in the presence of purchaser's engineers or when the inspection waiver has been given, in such a case, the testing shall be done at the manufacturer's works as per relevant IS / IEC stipulations and same should be confirmed by documentary evidence by way of Test Certificate which shall be got approved by the purchaser.
- 21.5 It is expected that before a Circuit Breaker is finally offered for inspection, internal testing of the same for various important parameters are already done. Routine test report for such tests shall also accompany the letter of inspection call so that the Inspecting Officer at the time of inspection may verify the parameters brought out in the preliminary report. Details of all tests should be clearly brought out.
- 21.6 In case for any reasons inspection is not completed or equipment is not found to be complete with all accessories as per confirmation given with the letter of inspection call, purchaser will reserve the right to recover the complete cost of deputation of inspecting team to the works of the manufacturer.
- 21.7 Acceptance of any quantity of circuit breaker & its accessories shall in no way relieve the successful Bidder of his responsibility for meeting all the requirement of this bid and shall not prevent subsequent rejection

if such equipments are later found to be defective.

20.1 QUALITY ASSURANCE PROGRAMME:

- 22.0 Bidders must establish that a proper quality assurance program is being followed by them for manufacture of circuit breakers. In order to ensure this, suitable QAP should form a part of the technical Bid, which will be submitted against this Bid. Quality Assurance Program must have a structure as detailed below.
- 22.1 Quality assurance and failure prevention starts with careful study and scrutiny of our technical bids and requirements. Supplier shall carefully study all the technical parameters and other particulars & the supplier shall categorically give his confirmation that these requirements shall be met in a satisfactory manner.
- 22.2 Supplier shall furnish the checks exercised in design calculations. The salient features of design will have to be made available to the Purchaser.
- 22.3 Supplier shall indicate the various sources of the items being procured. The type of checks, quantum of checks and acceptance norms shall be intimated and random test and check results should be made available for inspection whenever so desired. Vendor list for various bought out items shall be submitted with the Bid and the same shall be subject to purchaser's approval. However, no change in vendor list shall be acceptable after placement of order and list of vendors shall be freeze at the time of placement of order.

23.0 DOCUMENTATION:

- 23.1 Tenderer are advised to submit **OPTCL** approved copy of following drawings of the type offered for proper evaluation.
- i. General outline drawings showing dimensions net and shipping weights, quantity of insulating gas, air receiver capacity, lifting dimensions for maintenance etc. of circuit breaker and its local control panel.
 - ii. Sectional views showing the general constructional features of the circuit's breaker and its local control panel.
- 23.2 After receipt of the order, the successful tenderer will be required to submit the following drawings for approval:-
- a) General outline drawings showing dimensions and shipping weights, quantity of insulating media, air receiver capacity etc.
 - b) Sectional views showing the general constructional features of Circuit breaker including operating mechanism, arcing chambers, contacts with lifting dimensions for maintenance.
 - c) All drawings & data typical and recommended schematic diagram for control Supervision & reclosing.
 - d) Schematic diagrams of breaker offered for control supervision and reclosing.
 - e) Detailed drawing of operating mechanism.
 - f) Wiring diagram showing the local and remote control scheme of the breaker, including alarms, indicating devices, instruments, space heaters etc...
 - g) Master make list.
 - h) Structural drawing, design calculations and loading data for support structures.
 - i) Short circuit oscillogram & certificates for similar type tested breakers.
 - j) General arrangement of foundation and structure mounting plan including weights of varnish components and impact loading data for foundation design.
- 23.3 Two copies of operation, maintenance and erection manuals shall be supplied one month prior to the dispatch

of the equipment. The manuals shall be bound volumes and shall contain all the drawings and information required for erection, operation and maintenance of the equipment.

The manuals shall include amongst other things the following particulars:-

- i. Marked erection and prints identifying the components of the equipment with assembly drawings.
- ii. Detailed dimensions, assembly and description of the equipment and accessories.
- iii. List of Spare parts.

23.4 Successful Bidder shall, within two weeks of placement of order, submit two sets of final version of all the above drawings for purchaser's approval. Purchaser shall communicate his comments/approval on the drawings to the supplier within two weeks. Supplier shall, if necessary, modify the drawings and resubmit four copies of the modified drawings for purchaser's approval within two weeks from the date of comments. After receipt of purchaser's approval, the supplier shall, within three weeks, submit two prints of approved drawings for purchaser's use.

23.5 Successful Bidder shall also furnish two sets each of bound manuals covering erection, commissioning, operation and maintenance instructions and all relevant information and drawings pertaining to the main equipment as well as auxiliary devices along with each breaker. The supplier shall furnish detailed operation and maintenance manual of the mechanism along with the operation manual. Marked erection drawings shall identify the component parts of the equipment as shipped to enable erection by purchaser's own personnel. Each manual shall also contain one set of all the approved drawings, type test reports as well as acceptance reports of the corresponding consignment dispatched. Similar bound manuals for breakers shall be made available to the purchaser on one per breaker basis. Manufacturing of equipments shall be strictly in accordance with the approved drawings and no deviation shall be permitted without the written approval of the purchaser.

23.6 Approval of drawings/work by the purchaser shall not relieve Bidders of any of his responsibility and liability for ensuring correctness and correct interpretation of the drawings for meeting the requirements of the latest revision of the applicable Standards rules and codes of practices. Equipment shall conform in all respects to high standards of engineering, design, workmanship and latest revisions of relevant standards at the time of supply and purchaser reserves the right to reject any work or materials which, in his judgment, is not in full accordance therewith.

23.7 Additional data to be furnished along with the Bid:

- a) Drawing, showing contacts in close, arc initiation, full arcing, arc extinction and open position.
- b) Data on capabilities of circuit breakers in terms of time and number of operations at duties ranging from 100% fault currents to load currents of the lowest possible value without requiring any maintenance or checks.
- c) Effect of non-simultaneity between contacts within a pole or between poles and also how it is covered in the guaranteed total break time.
- d) Details and type of filters used in interrupter assembly and also operating experience with such filters.

24.0 PACKING AND FORWARDING:

Equipment shall be packed in suitable crates in such a manner to protect it from damage and withstand handling during transit. Supplier shall be responsible for and make good at his own expense, any or all damage to the equipment during transit. Fragile materials shall be carefully packed and marked with the appropriate caution symbols. Wherever necessary, proper arrangement for lifting such as lifting hooks etc. shall be provided. Each consignment shall be accompanied by a detailed packing list containing the following

information:

- a) Name of the consignee.
- b) Details of consignment.
- c) Destination.
- d) Total weight of consignment.
- e) Sign showing upper/lower side of the crate.
- f) Handling and unpacking instructions.
- g) Bill of material indicating contents of each Lot

Supplier shall ensure that the packing list and bill of material are approved by the purchaser before dispatch.

25.0 COMPLETENESS OF EQUIPMENT AND BOUGHT OUT ITEMS:

Bidders must furnish the following information along with technical Bid:

- 25.1 Complete details of all the accessories which will be supplied with Circuit breaker should be furnished. While furnishing these details, items which will be manufactured by Supplier and balance items, which will be procured from sub-suppliers should be clearly identified and indicated in the Bid.
- 25.2 It is obligatory on the part of Supplier to ensure that supply of all accessories along with main equipment is simultaneously delivered to avoid any holdup in erection and commissioning. The responsibility for obtaining timely supplies of bought out items will rest on Supplier and only on this basis, delivery period will be offered in the Bid.
- 25.3 It may be noted that in case of damages/shortages due to improper packing or any other negligence, replenishment shall be arranged within one month time. For bought out items, responsibility for guarantee and obtaining immediate replacement in case any defects are noticed and also in case defective supply of any item is reported, will rest with the Supplier. In case for attending to defects in any accessory or inspection/replacement of the accessory, which may be bought out item for the Supplier; if services of engineer of original manufacturer is required, the same will be organized on immediate basis by Supplier at his cost.

26.0 SPECIFIC TECHNICAL REQUIREMENTS OF VACUUM CIRCUIT BREAKERS:

- 26.1 Circuit breakers shall comprise of three identical pole units linked together mechanically suitable for operation with a centrally located common operating mechanism box. Vacuum circuit breakers with all integral parts required for satisfactory operation shall be supplied with all accessories in position and complete internal wiring connected and terminated in the operating mechanism housing. Offered equipment shall be complete in all respect.
- 26.2 The contacts of the circuit breaker shall be of Butt type.

26.3 VACUUM INTERRUPTERS:

1. Design of vacuum interrupter shall be such that it gives trouble free operation under normal load and fault condition throughout the life of the equipment. As the efficiency of breaker depends on degree of vacuum inside the interrupter, manufacturer shall ensure that the same is maintained consistently during service.
2. Insulating ceramic body of interrupter shall have high mechanical strength and it shall be capable of withstanding high temperature without any significant deterioration in mechanical and electrical properties.
3. Interrupter design shall ensure rapid deionization of the gap so that normal electrical strength of the gap is restored instantaneously.
4. Vacuum interrupters shall be so designed and augmented that a uniform voltage distribution is developed

across them. Calculation/ test reports in support of the same shall be furnished along with the tender. Thermal and voltage withstand values of the grading elements shall be adequate for the service conditions and duty specified.

5. Metallic bellow or the other sealing arrangement should be provided at the moving contact and should have long fatigue free life. Manufacturers' catalogue on vacuum bottle, indicating all such details shall essentially be submitted.
6. Breaker assemblies with base, support structure for circuit breaker as well as for control cabinet, foundation bolts and Breaker terminals shall be hot dip galvanized.
7. Facilities shall be provided for monitoring the contact erosion and any change in contact gap. The vacuum bottles shall be easily replaceable on site and the mechanism shall be conveniently adjustable to permit resetting the contact gap.
8. All necessary parts to provide a complete and ready to use circuit breaker installation such as main equipment; terminal connectors, control parts, cable connector, pipe lines and other devices, whether specifically called for herein or not.
9. All gasketed surfaces shall be smooth, straight and reinforced to minimize distortion and to make a tight seal. Operating rod connecting the operating mechanism to the arc chamber shall have adequate seals, single "O" ring seals without test holes. Double "O" ring seals or double lip seals and test holes for leakage test of the internal seal shall be provided on each static joint.
10. Special contacts for use with the trip coils and single shot reclosing operation, which permit the relative adjustment with respect to the travel of Circuit breaker, shall also be provided.

26.4 CONTROL CABINETS:

1. Operating mechanism and all accessories shall be enclosed in weather & vermin proof mechanism cabinet of hot dip galvanized sheet steel construction, the thickness of which shall not be less than 3 mm intended for outdoor operation. Control cabinets shall be provided with a hinged door. Door hinges shall be of union joint type for easy access to the mechanism at the front. Sides shall be properly braced to prevent wobbling. Suitable gasket shall be provided to make the mechanism housing waterproof and dust proof. Housing latch shall accommodate padlock requiring a 12mm dia hole. Padlock and duplicate keys are also included in the scope of supply.
2. Isolating switches shall be group operated units quick make quick break type, capable of breaking safely and without deterioration, the rated current of the associated circuit. Control cabinet door shall be interlocked with the operating handle of the switch so as to prevent opening of the door when the switch is closed. A device for bypassing the door interlock shall also be provided. Switch handle shall have provision for locking in both fully open and fully closed positions.
3. Fuses shall be HRC cartridge link type having prospective current rating of not less than 4.6kA (rms). They shall be provided with visible operation indicators to show when they have operated. One fuse pulling handle shall be supplied for every ten fuses or a part thereof.
4. Push button shall be rated for not less than 2 Amps, 110V DC and shall be flush mounted on the cabinet door and provided with appropriate nameplates. Red, Green and Amber indicating lamps shall be flush mounted and provided with series resistors to eliminate the possibility of short circuiting of control supply in the event of fusing of lamps.
5. For motors up to 5 kW, contactors shall be direct-on-line, air break, single throw type and shall be suitable for making and breaking the switching current of the associated motor which shall be assumed equal to 6.5 times the full load current of the motor. Reversing contactors shall be provided with electrical interlocks between forward and reverse contactors. If possible, mechanical interlocks shall also be provided. Contactors shall be

suitable for uninterrupted duty and shall be of duty category class as per IS: 2959. The main contacts of the contactors shall be silver plated and the insulation class for the coils shall be class E or better. Dropout voltage of the contactors shall not exceed 70% of the rated voltage.

6. Contactors shall be provided with a three element, positive acting, ambient temperature compensated, time lagged, hand reset type thermal overload relay with adjustable setting alternatively MCB for motor protection. Hand reset button shall be flush with the front door of the cabinet and suitable for resetting with starter compartment door closed. Relays shall be either directly connected or CT operated depending on the rated motor current.
7. Purchaser's power cables will be of 1100/650 volts grade stranded aluminium conductor. PVC insulated, PVC sheathed single steel wire armoured and PVC jacketed. All necessary cable terminating accessories such as glands, crimp type tinned copper lugs etc. for power as well as control cables shall be included in Bidder's scope of supply. Requisite number of suitable brass cable glands shall be provided for cable entry at the bottom of the operating cabinet to receive purchaser's control cables. These shall be mounted in accessible position and floor level so that the cable joints can be made easily. Cable glands shall be double compression type.
8. Separate terminal blocks shall be provided in the mechanism housing for terminating circuits of various voltage classes. Terminals for DC & AC shall be provided separately and isolated from each other. Terminals for the control & other circuits shall be suitable for accommodating 3mm stranded conductor cable leads. A minimum of six spare terminals for control wiring shall be provided. Housing shall be complete with all necessary wiring in the housing.
9. Wiring for all control circuits shall be carried out with 1100/650 volts grade PVC insulated tinned copper stranded conductors of sizes not smaller than 2.5 mm. Atleast 20% spare terminal blocks for control wire terminations shall be provided on each panel. All terminals shall be provided with ferrules indelibly marked or numbered and these identifications shall correspond to the designations on the relevant wiring diagrams. Terminals shall be rated for adequate capacity which shall not be less than 10 Amps.
10. Control cabinet shall be provided with 230 V, 1-phase 50 Hz, 20 W fluorescent light fixture and a suitably rated 230V, 1 phase, 5 amps, 3 pin sockets for hand lamps. Suitably rated power plug with switches shall be provided to enable the control supply to Breakers to be cut off from the mechanism housing.
11. Suitable strip heaters shall be provided inside each cabinet complete with thermostat to prevent moisture condensation. Heaters shall be controlled by suitably rated double-pole miniature Circuit Breakers and by differential thermostat so that the cubicle temperature is always maintained approximately 10 deg./ above the outside air temperature. On-Off switch and fuse shall be provided. Heater shall be suitable for 230 volts AC supply unless otherwise specified.
12. Signal lamps provided shall be of neon screw type with series resistors, enclosed in bakelite body. Each signal lamp shall be provided with a fuse integrally mounted in the lamp body.
13. Items inside the cabinet made of organic material shall be coated with a fungus resistant varnish.
14. All doors, panels' removable covers and breaker openings shall be gasketed all around.
15. All louvers shall have screen and filters. Cabinet shall be dust, moisture, and vermin proof.
16. All cabinets/boxes shall be designed for the entry of cables from bottom by means of weather proof and dust-proof connections. Suitable cable gland plate (at least 150 mm above the base of cabinet/box) of HDG having minimum thickness of 3 mm, with necessary cable glands shall be provided. The cable gland plate shall be removable type and shall have provision for additional glands for future. The glands shall have provision for securing armour of the cable separately and shall be provided with earthing tag. The glands shall be cadmium plated. The cabinet/box shall be designed generously for clearance so as to avoid interference between the wiring entering from below and any terminal block or accessories mounted within the box or cabinet.
17. Suitable relay for monitoring of DC supply voltage to the control cabinet shall be provided. In case the contacts are not adequately rated and multiplying relays are used then the interlock for closing/ opening operation shall be independent of the relay logic i.e. if the DC supply to the interlock circuit fails then operation lockout shall take place.

26.5 SERVICES FOR SUPERVISION OF TESTING & COMMISSIONING OF CIRCUIT BREAKERS:

It is obligatory on the part of the Bidder to provide “free services” of their senior commissioning engineer to supervise Testing & commissioning of each Circuit Breaker. It may be clarified that the breaker shall be made ready for commissioning in all respect and services of your engineer will be required for checking and final commissioning of the breaker. Normally PURCHASER has trained staff for commissioning of breaker based on guidelines, which are to be furnished by the manufacturer. While undertaking Testing & commissioning work, the purchaser will require services of supervision engineer for suitable period depending upon design of equipment and these services for required period will have to be made available on free of cost basis. In case any manufacturer feels that their experienced engineer for final supervision of erection and testing will need assistance of any junior grade supervisor also, services of the same should also be provided on free of cost basis. In any case free services by way of deputation of required number of personnel for sufficient period will have to be ensured by the bidder on free of cost basis. The intention is that the services are made available until supervision of Testing & commissioning is completed. These services shall be provided for each unit. It will be obligatory on the part of bidders to depute their commissioning engineer positively within one week of telephonic intimation from PURCHASER.

27.0 LIST OF MANDATORY SPARES

The bidder shall provide the following spare parts for circuit breakers for breaker free of cost.

- a. Vacuum interrupter bottle - One no
- b. Trip coil - Two nos.
- c. Closing coil - Two nos.
- d. Spring charging motor - Two nos.

One set of special tools, if any, required for assembly and maintenance of the circuit breaker shall be supplied.

ANNEXURE-1

PRINCIPAL PARAMETERS FOR 33kV VACCUMCIRCUIT BREAKERS

Sl.No	Description	Requirements
1	Nominal system voltage (kV rms)	33
2	Highest system voltage (kV rms)	36
3	Rated frequency (Hz)	50
4	Rated normal current (Amperes rms) at 50°C ambient temperature	1250
5	Type	E2-M2-C2
6	Duty requirements	Normal duty
7	Mounting structure details	Hot dip galvanized lattice steel support structure
8	System neutral earthing	Effectively earthed
9	Number of poles	3
10	Type of operation	Suitable for three pole tripping and closing i.e. normal duty
11	Minimum clearances - (mm) a) Between phases b) Phase to Earth c) Between live parts and grounded objects	505 305 1400
12	Ground clearance from the lowest live terminal to breaker structure base plate (to be fixed on concrete plinth)	3700
13	Height of concrete plinth provided by purchaser (mm)	300
14	Operating mechanism	Spring operating mechanism with electrical controls
15	Rated operating sequence	0-0.3 sec -CO-3min- CO
16	First pole to clear factor	1.5
17	Type of tripping	Trip free
18	Maximum closing time not exceeding (milli seconds)	80
19	Maximum total break time (milli seconds)	<60
20	Circuit breaker opening time (milli seconds)	<40
21	Insulation level of breaker a) 1.2 / 50 μ s lightning impulse withstand voltage (kVp)	170
	b) One minute power frequency withstand voltage (kVrms)	75
22	Rated Short circuit breaking Current	31.5KA for 3 s

23	Out of phase breaking current capacity (kA)	6.25
24	Reactive loaded transformer interrupting capacity.	Bidder may state Limiting values, if applicable.
25	Rated short circuit making current capacity (kA)	78.75
26	Power Transformer duty requirement	Inrush current of 20MVA Transformer
27	Permissible limit of temperature rise	As per IEC
28	Maximum acceptable difference in the instance of closing/opening of contacts: i. Within a pole (milli-second)	5
	ii. Between poles (milli-second)	10
29	Total creepage distance of support insulator (mm)	1116
30	Short time current carrying capability	31.5KA for 3s
31	Breaking capacity of auxiliary contacts	10 A (With circuit time constant less than 20 ms)
32	Maximum Noise level at base and up to 50 meters (dB)	140
33	Rated line charging current breaking capacity (Amps)	As per IEC
34	Trip coil and closing coil voltage	220 V DC
35	No of Trip Coils	TWO

ANNEXURE-2
GUARANTEED TECHNICAL PARTICULARS

Sl.No	Description	33KV VCB
1.	Name of manufacturer	
2.	Manufacturer's type and designation	
3.	Governing standard	
4.	Rated Voltage (kV)	
5.	Highest system voltage (kV)	
6.	Frequency (Hz)	
7.	Class (indoor or outdoor)	
	Normal current rating (approx.)	
8.	Under standard conditions Under site conditions Derating factor, if any, for site conditions	
9.	Short-time current rating (kA) for 3 sec	
10.	Rated short circuit breaking current	
	a) Rated short circuit current (A.C. component)	
	b) Percentage D.C. component	
	c) Asymmetrical breaking current (including D.C component)	
11.	Making capacity (kAp)	
12.	Total break time (milliseconds)	
	a) For interruption of 10% of the rated capacity	
	b) For interruption of 30% of the rated capacity	
	c) For interruption of 60% of rated capacity	
	d) For interruption of the full rated capacity	
13.	Arcing time (milliseconds)	
14.	Minimum reclosing rated interrupting capacity from the instant of the trip coil energisation (milliseconds)	
15.	Minimum dead time	
	a) 3-phase reclosing (milliseconds)	
	b) Limit of adjustment of dead time for 3-phase reclosing	
16	Rate of re-striking voltage for 100%, 50% or 30% rated capacity.	
	a) Amplitude factor b) Phase factor	
	c) Natural frequency (Hz)	
	d) Rate of rise of re-striking voltage (kV/ μ s)	
17	a) Recovery voltage when circuit breaker tested at 100% rated breaking capacity (kV)	
	b) Rate of rise of re-striking voltage at breaking	
	i). For 30% breaking capacity, (kV/ μ s)	
	ii). For 100% breaking capacity (kV/ μ s)	

	c) Maximum over voltage factor of the circuit breaker when switching off i) Unloaded transformers ii) Loaded transformers iii) Open circuited lines	
18	When switching of synchronous systems a) Max. Current (kA) b) Max. Voltage of I pole (kV)	
19	Maximum interrupting capacity under phase opposition condition (MVA)	
20	Maximum line charging current breaking capacity without over-voltage exceeding 2.5 times the rated phase to neutral voltage (Amps.)	
21	Maximum cable charging current breaking capacity and corresponding over voltage recorded in test a) On supply side. b) On line side.	
22	Maximum breaking capacity on kilometric faults (MVA)	
23	Dry 1-minute power frequency test with stand voltage, for complete circuit breaker a) Between line terminals and grounded parts (kV rms) b) Between terminal with breaker contacts open (kV rms)	
24	Wet one minute power frequency test withstand voltage for complete circuit breaker a) Between line terminals and grounded parts (kV rms) b) Between terminal with breaker contacts open (kV rms)	
25	Whether the circuit breaker is fixed trip or trip free	
	SUPPORTING INSULATORS	
26	Make and Type	
27	Weight	
28	Transport dimensions	
29	Height above pole required to remove porcelain (mm)	
30	Insulation class.	
31	Visible corona discharge voltage.	
32	Dry 1 minute power frequency flashover voltage (KV rms)	
33	Wet 10 sec. power frequency flashover voltage (KV rms)	
34	Lightning impulse flashover voltage (KV peak)	
35	Nature of dielectric.	
36	Total minimum Creepage distance (mm)	
37	Minimum clearance in air a) Between phases (mm) (Live parts) b) Live parts & earth (mm) c) Live parts to ground level (mm) d) Center to center distance between phase (mm)	
38	Permissible safe cantilever loading on installed porcelain (Kg.m)	
	CONSTRUCTIONAL FEATURES:	
39	No. of poles per circuit breaker	
40	No. of break per pole	
41	Length of contact travel (mm)	

42	Total length of breaks per phase (mm)	
43	Rate of contact travel	
	a) At tripping (millimeters/sec) b) At closing (millimeters/sec.)	
44	Type of main contacts	
45	Material of main contacts	
46	Whether main contacts Silver plated (Yes/No)	
	<ul style="list-style-type: none"> • Thickness of silver coating on main contracts (mm) • Type of arcing contacts & material • Contact pressure on arcing contacts (KG/m2) 	
47	Type of auxiliary switches	
48	Material of switch contacts	
49	Whether contacts silver plated (Yes/No)	
50	No. of auxiliary switch contacts operating with all the three poles of a breaker	
	a) Which are closed when breaker is open (NC) b) Which are open when breaker is open (NO) c) Those adjustable with respect to the position of main contacts	
51	No. of auxiliary switch contacts operating with individual pole of a breaker	
	a) Which are closed when breaker is open (NC) b) Which are open when breaker is open (NO) c) Those adjustable with respect to the position of main contacts	
52	No. of spare auxiliary switch contacts operating with all three poles of a breaker	
	a) Which are closed when breaker is open (NC) b) Which are open when breaker is open (NO) c) Those adjustable with respect to the position of main contacts	
53	No. of spare auxiliary switch contacts operative with individual pole of Breaker	
	a) Which are closed when breaker is open (NC) b) Which are open when breaker is open (NO) c) Which are adjustable with respect to the position of main contact	
54	No. of operations possible without maintenance	
	a) At full rated interrupting capacity b) At 50% of rated interrupting capacity c) At 100% of rated current d) At 50% of rated current	
55	Mounting flange details (PCD & Diameter)	
56	Method of closing	
	a) Normal Electrical/Mechanical b) Emergency Electrical/Mechanical	
57	Type of closing mechanism (spring)	
	a) Normal voltage of closing b) Pick up range, (Volts)	
58	Power at normal voltage of closing mechanism (watts)	
59	Power at 85% normal voltage (watts)	
60	Type of tripping mechanism (spring)	

61	Normal voltage of tripping coils (Volts)	
62	Power at normal voltage for tripping coils (watts)	
63	Power at 70% normal voltage for tripping coils (watts)	
64	Arc duration at 100% interruption capacity (ms) Opening	
65	Total length of the arc (mm)	
66	Max. length of the arc (in sec)	
67	Total interrupting time measured from instant of trip coil opening of main contact	
68	Closing time measured from instant of application of power to closing device up to closing of main contact	
69	Critical current (current giving the longest are when a break takes place) (KA)	
70	Contingencies for which alarm provided	
71	Design data for supporting structure	
72	Weight of supporting steel structure per breaker	
73	a) Weight of complete circuit breaker (Kg.)	
	b) Impact loading for foundation design, to include dead load plus impact value on opening at maximum interrupting ratings, in terms of equivalent static load (kg)	
	c) Overall dimensions: Height (mm) Width (mm) Length(mm)	
74	Descriptive leaflets enclosed	
75	Quantity of absorbent required per pole (Kg.)	
76	Recommended interval for renewal of absorbent in case of outdoor circuit breakers operating in tropical conditions	
77	Chemical composition of the absorbent	
78	Quantity of absorbent covered in the scope of supply (including spare quantity) (Kg.)	
79	Type of operating mechanism offered	
80	Recommended overhauling intervals for	
	a) Circuit Breakers b) Spring operating system.	
81	Details of Control Cubicle	
	(a) Degree of Protection : (b) Type and thickness of gasket :	
82	Details of counter	
83	Electrical (counter).	
84	Spares supplied free of cost with each C.B	
	i) Trip coil (1 set)	
	ii) Closing coil (1 set)	
85	Special tools, required for assembly & maintenance of circuit breakers	

PART-11
33KV OUTDOOR
DISCONNECTOR

TECHNICAL SPECIFICATION OF 36 kV ISOLATORS

1.0 SCOPE

The scope covers design, engineering, manufacturing, stage testing, inspection and testing before dispatch, packing, forwarding and delivery at site of 36kV Isolator and earth switch complete with all fittings, accessories and associated auxiliary equipment mandatory spares which are required for efficient and trouble free operation as specified hereunder for "M/S. OPTCL."

2.0 STANDARDS

2.1 The Equipment offered shall confirm to the following standards

Sl. No	Indian standard	Title	International standard
1	IS:9921Part (1-5)	Alternating current isolators (disconnectors) & earth switches	IEC 62271-102
2	IS:2544	Specification for Porcelain post Insulators with nominal voltages greater than 1000 Volts	-
3	IS:2629	Recommended practice for hot dip galvanizing of iron and steel	-
4	IS:4759	Hot dip zinc coating on structural steel and other allied products	-
5	IS:2633	Method of testing weight thickness and uniformity of coating on fasteners.	-
6	IS:1573	Electroplated coating of zinc or iron and Steel	-
7	IS:5561	Specification for Electric power connectors	-
8	IS:2016	Plain washers	-
9	IS:2165	Insulation Co-ordination	-
10	IS:2544	Insulators	-
11	IS:5350	Dimensions of Indoor and Outdoor Porcelain Post Insulators and Post Insulator Units for Systems with nominal Voltages Greater than 1000 V - Part 2	-
12	-	Tests on indoor and outdoor post insulators of ceramic material or glass for systems with nominal voltages greater than 1000 V	IEC 60168
13	-	Characteristic of indoor and outdoor post insulators for systems with nominal voltages greater than 1000 V	IEC 60273
14	-	Indian Electricity Rules 1956	

Equipment meeting with the requirements of other authoritative National or International Standards, which ensure equal or better performance than the standards mentioned above, shall also be considered. It is not the intent to specify completely herein all details of the design and construction of equipments. However, the equipment shall conform to standards of engineering, design and workmanship.

3.0 SERVICE CONDITIONS

3.1 The Isolators and its accessories supplied against this specification shall be suitable for satisfactory and continuous operation under the following tropical conditions.

S. No.	Particulars	Conditions
1	Location	Outdoor
2	Maximum ambient air temperature ($^{\circ}$ C)	50
3	Minimum ambient air temperature ($^{\circ}$ C)	5
4	Average daily ambient temperature ($^{\circ}$ C)	32
5	Maximum Relative humidity (%)	100
6	Maximum altitude above mean sea level (m)	<1000
7	Basic Wind Speed (m/s)	50
8	Isokeraunic level (days / year)	70
9	Seismic level	Zone III as per IS 1893
10	Degree of Pollution	31 mm/kV
11	Site Location	Angul. State of ODISHA

3.2 AUXILIARY POWER SUPPLY

The equipments offered under this specification shall be suitable for the following auxiliary power supplies.

a.	Power Devices (like drive motors)	415 Volt, 3 phase, 4 wire, 50 Hz, neutral grounded AC supply.
b.	AC control and protective devices, lighting fixtures, spare heaters & fractional horse power motors	230 Volt, single phase, 2 wire, 50 Hz, neutral grounded AC supply
c.	DC Alarm, Control & Protective devices	220 V

The above supply voltages may vary as below and all devices shall be suitable for continuous operation over entire range of voltages.

- i. AC supply voltage - 15% to + 10%, frequency \pm 5%
- ii. DC supply - 15% to + 10%

4.0 DUTY REQUIREMENTS

- 4.1 The isolator shall have mechanical endurance of 10000 operating cycles – class M2 and earth switch shall be E0. The Principal parameters for the Isolators shall be as per Appendix 1.
- 4.2 Isolators and earth switches shall be capable of withstanding the dynamic and thermal effects of the maximum possible short circuit current of the systems in their closed position. They shall be constructed such that they do not open under influence of short circuit current.
- 4.3 The earth switches, wherever provided, shall be constructionally interlocked so that the earth switch can be operated only when the isolator is open and not vice-versa. The constructional interlocks shall be built-in construction of isolator and shall be in addition to the electrical and mechanical interlocks provided in the operating mechanism.
- 4.4 In addition to the constructional interlock, isolator and earth switches shall have provision to prevent their electrical and manual operation unless the associated and other interlocking conditions are met. All these interlocks shall be of failsafe type. Suitable individual interlocking coil arrangements shall be provided. The interlocking coil shall be suitable for continuous operation from DC supply and within a variation range stipulated in this specification.
- 4.5 The isolator shall be capable of making/breaking normal currents when no voltage occurs across the terminals of each pole of isolator on account of make/break operation.
- 4.6 The isolator shall be capable of making/ breaking magnetizing current of 0.7A at 0.15 power factor and capacitive current of 0.7 A at 0.15 power factor.
- 4.7 Isolator and earth switches shall be able to bear on the terminals the total forces including wind loading and electro dynamic forces on the attached conductor without impairing reliability or current carrying capacity.

5.0 GENERAL TECHNICAL REQUIREMENTS FOR ISOLATOR WITH OR WITHOUT EARTH SWITCH

5.1 TYPE & RATING

- 5.1.1 The three phase double break Isolators shall have three posts per phase triple pole single throw, gang operated outdoor type, silver plated contacts with horizontally operating blade and isolators posts arranged vertically. Rotating blade feature with pressure relieving contacts is necessary, i.e. the isolators shall have turn and twist arrangement. This arrangement shall be described in details along with the bid. However, the design of turn & twist arrangement shall be to our approval. Banging type feature is not acceptable.
- 5.1.2 All isolators with/ without earth switch shall operate through 90 degree from their fully closed position to fully open position, so that the break is distinct and clearly visible from the ground level. The Isolators will have manual operating mechanism with worm and reduction gear. The earth switch shall have separate operating mechanism but without worm and reduction gear.
- 5.1.3 The equipment offered by the bidders shall be designed for a normal current rating of 1250 Amps. Isolators shall be suitable for continuous service at the system voltages specified herein. The isolators are not required to operate under load but they must be called upon to handle magnetisation currents of the power transformers and capacitive currents of bushings, bus bar connections, very short lengths of cables & current of voltage transformers and dividers.

5.1.4 Material of earthing blades and contacts shall be same as those of main blades and contacts. Cross sectional area of earthing blades and contacts shall not be less than 50% of cross sectional area of main blades and contacts. The earthing blades shall have the same short time current rating (thermal and dynamic) as that of main blades.

5.1.5 The rated insulation strength of the equipment shall not be lower than the levels specified in IEC 62271-102.

5.2 TEMPERATURE RISE

The maximum temperature attained by any part of the equipment when in service at site under continuous, full load conditions and exposed to the direct rays of sun shall not exceed the temperature limits specified in IS 9921 Part 2. The limit of temperature rise shall not be exceeded when corrected for the difference between ambient temperature at site and the ambient temperature specified in the approved specifications. The corrections proposed shall be stated in the bid and shall be subject to approval of the purchaser.

5.3 ISOLATOR INSULATION

5.3.1 Insulation to ground, insulation between open contacts and the insulation between phases of the completely assembled isolating switch shall be capable of withstanding the dielectric test voltage specified in IS-9921. Insulation between open contacts of a pole shall be at least 15% more than the insulation between the live parts of pole to ground.

5.3.2 The support Insulators shall be solid core type only.

5.3.3 The insulator shall be made of homogeneous and vitreous porcelain of high mechanical and dielectric strength. It shall have sufficient mechanical strength to sustain electrical and mechanical loading on account of wind load, short circuit forces etc., Glazing of the porcelain shall be of uniform brown or dark brown colour with a smooth surface arranged to shed away rain water. The porcelain shall be free from lamination and other flaws or imperfections that might affect the mechanical or dielectric quality. It shall be thoroughly vitrified, tough and impervious to moisture. The porcelain and metal parts shall be assembled in such a manner and with such material that any thermal differential expansion between the metal and porcelain parts throughout the range of temperature specified in this specification shall not loosen the parts or create undue internal stresses which may affect the mechanical or electrical strength or rigidity. The assembly shall not have excessive concentration of electrical stresses in any section or across leakage surfaces. The cement used shall not give rise to chemical reaction with metal fittings. The insulator shall be suitable for water washing by rain or artificial means in service condition.

5.3.4 The post insulators offered should preferably have the length of the shortest puncture path through solid insulating material at least equal to half the length of the shortest flashover path through air outside the insulator.

5.3.5 The insulators shall be fabricated by the wet process. The porcelain and galvanized metal parts shall be assembled together with such material and in such manner that any thermal expansion of the metal and ceramic parts throughout the range of over rating temperatures shall not lose the parts to create undue stress adversely affecting the mechanical and electrical strength.

5.3.6 The cement use in the construction of the post insulators shall not cause fracture by expansion or loosening by contraction and proper care shall be taken to locate correctly the individual parts during cementing.

- 5.3.7 All ferrous metal parts except those of stainless steel shall be hot dip galvanized and the uniformity of the Zinc coating shall satisfy the requirements of IS: 2633, the metal parts shall be galvanized after machining.
- 5.3.8 The threads of tapped holes in the post insulators metal fittings shall be cut after giving anticorrosion protection and shall be protected against rust, all other threads shall be cut before giving anticorrosion protection.

Solid core post insulator shall meet the specific technical requirements below

Sl.No.	Description	
1	No. of units per stack	1
2	Nominal system voltage (kV)	33
3	Highest system voltage (kV)	36
4	Size of Insulators Height	508 mm
5	PCD of metal fittings a-Top b-Bottom	76 mm 76 mm
6	Creepage distance	1116 mm/kV
7	Dry flashover voltage (kV rms)	125
8	Wet flashover voltage (kV rms)	100
9	Dry withstand voltage (kV rms)	95
10	Wet withstand voltage (kV rms)	80
11	Impulse flashover voltage 1.2/50 μ s wave (kVp)	225
12	Impulse withstand voltage 1.2/50 μ s wave (kVp)	170
13	Tensile strength (kN)	30
14	Compression strength (kN)	60
15	Torsion failing load (kN-m)	1.5
16	Bending strength (kN)	6
17	Rated frequency (Hz)	50
18	Minimum discharge voltage (kV)	27

The isolators are to be supplied with mounting base channel and fixing nuts and bolts.

5.3.9 TESTS

The type tests shall be done as per IEC 60168. Routine and acceptance tests on the solid core post insulators shall be conducted in the presence of the purchaser's representative, if so desired by the purchaser. All test reports shall be submitted and got approved.

5.4 MAIN CONTACTS

- 5.4.1 All isolators shall have heavy duty self-aligning and high pressure line type fixed contact of modern design and made of hard drawn electrolytic copper. The fixed female contact should be of reverse loop type. The various parts shall be accordingly finished to ensure interchangeability of similar components. The fingers of fixed contacts shall be preferably in three pieces and each shall form the reverse loops to hold moving contacts. Stopper provided in the fixed contact will overlap inside reverse loop assembly strips to stop over travel of moving contact pipe. It should be made of material having high melting point e.g. Teflon to withstand rise in temperature. The screw to secure the stopper in fixed contact for moving pipe should be flushed properly to avoid damage to moving contact surface. The fixed contacts would be placed in 'C' clamp. The thickness of Jaw holding bracket ('C' clamp) to hold fixed contact jaws should not be less than 6 mm made of HDG Mild steel. This 'C' clamp shall be placed on a channel of adequate thickness. This channel shall be welded on a insulator mounting plate of 8 mm thickness. The spring of fixed contact shall have housing to hold in place. This spring shall be made of stainless steel minimum thickness of 14 SWG. The cap on spring should be made of Teflon to withstand rise in temperature. The pad for connection of terminal connector shall be of Aluminium Alloy.
- 5.4.2 Suitable rain hood shall be provided overlapping the bushes on turn twist arrangement to prevent accumulation of dust and other foreign particles so as to avoid jamming of rotation of moving contact pipe. Center post top pin for holding the turn & twist assembly should be adequate in size to avoid any bending of turn twist mechanism. Nut & bolt arrangement is preferable to hold the pin in place of lock pin. The turn & twist assembly of moving centre post top contact should be provided with sealed ball bearing at centre of mechanism. Flat washers 2 Nos. on each side of turn and twist spring may be provided (4 Nos.). In turn and twist mechanism size of hook lever should not be less than 20 mm.
- 5.4.3 The switch blades forming the moving contacts shall be made from tubular section of hard drawn electrolytic copper having outer diameter not less than 38 mm and suitable thickness. These contacts shall be liberally dimensioned so as to withstand safely the highest short-circuit and over voltages that may be encountered during service. The surfaces of contacts shall be rendered smooth and silver plated. The thickness of silver plating shall not be less than 25 microns. In nut shell, the male and female contacts assemblies shall be robust construction and design of these assemblies shall ensure
- a. Electro-dynamic with stand ability during short circuit without any risk of repulsion of contacts.
 - b. The current density in the Copper parts & Aluminium parts shall be less than 2.0 Amp/sq.mm & 1.25 Amp/sq.mm respectively.
 - c. Thermal withstand ability during short circuit
 - d. Constant contact pressure even when the live parts of the insulator stacks are subjected to tensile stresses due to linear expansion of connected bus bar of flexible conductors either because of temperature variations or strong winds.
 - e. No wiping action during closing and opening.
 - f. Self-alignment assuring closing of the switch without minute adjustment. The details/drawings of contacts, springs, fixing arrangement, contact pressure, current transfer assembly, limit of temperature rise etc., shall be furnished along with the bid.
- 5.4.4 The thickness of moving contact pipe should be uniform on the periphery at all points. Due care should be taken to ensure that the copper pipe of good quality from reputed source and of electrolytic grade only is utilized in manufacture of moving contacts. The moving contact pipe should be supported with 2 mm thickness

brass bushes at rotating points with lubricating facility for smooth operation. The bushes should be machined having one side proper collar and other side to be press fitted. The earthing switches shall each be provided with three sets of suitable type of fixed contacts below the fixed contacts assemblies of the main switch on the incoming supply side and three sets of moving contacts having ganged operation. These contacts too shall be fabricated out of electrolytic copper for isolators with earth switch and dimensioned to withstand the current on the line. Nut & Bolts of minimum 12 mm size shall be used, except in case of current carrying parts.

5.5 ARCING CONTACTS

Arcing contacts of first to make and last to break type shall be provided for main contacts.

5.6 AUXILIARY SWITCHES

5.6.1 The isolators shall be provided with 220 Volt DC auxiliary switches for their remote position indication on the control board and for electrical interlocking. The auxiliary switch shall have the following number of contacts

- a. For all earthing switches: 4 pairs of normally open and 4 pairs of normally closed.
- b. For all main isolators : 10 normally open and 10 normally closed set of contacts.

In addition two pairs of Make-before-break NO/NC contacts shall be provided in the operating Mechanism box.

5.6.2 All contacts should be brought out on terminals. Provision shall be kept for adding more auxiliary switch contacts at a later date. Auxiliary switches shall be of robust construction of some reputed make and housed in weather proof, vermin proof, and dust free covers mounted on the respective operating mechanism. Schematic diagram for set of contacts shall be furnished. The auxiliary switches should be positive type. They are spring loaded so that contacts are either NO or NC. The wire connection to the auxiliary switches shall be through suitable lug screwed to the switch. The connection to the auxiliary switch should be screw on type.

5.6.2 The auxiliary switches shall be capable of carrying the current of at least 10 Amps continuously and shall be capable of breaking at least 2A in 220V DC circuit, with time constant of not less than 20 milliseconds. The auxiliary switches shall be actuated by a cam or similar arrangement directly mounted on the isolator and shall be without any intermediate levels/ linkages to ensure fool proof operation.

5.6.3 It shall be possible to change normally closed contact into normally open contacts and vice versa at site.

5.7 CLAMPS/ CONNECTORS

i) The clamps/connectors shall be made of Aluminium alloy Grade A6 as per IS: 5561 and shall be suitable for single zebra ACSR with suitable arrangement. The exact requirement to terminal clamps would be finalised by the bidder in consultation with owner based on layout requirement. The details in regard to dimension, the number of bolts to be provided, material and manufacture shall be furnished in the bid.

ii) The design of clamp shall be to our approval. The clamps to be offered should be manufactured by gravity die-casting method only and not by sand casting process.

iii) It is necessary that suitable clamps are offered along with the isolator and also it is obligatory to give complete technical particulars of clamps along with the drawing, and as per following details.

a. The terminal connector shall be manufactured and tested as per IS- 5561 or equivalent International standard.

- b. All castings shall be free from blow holes, surface blisters, cracks and cavities. All the sharp edges shall be blurred and rounded off.
- c. No part of the clamp shall be less than 12 mm thick. The minimum size of terminal connector pad for fixing on isolator pad shall be 100 mm x 100 mm.
- d. All current carrying parts shall be designed and manufactured to have minimum contact resistance.
- e. Connectors shall be designed to be corona free as per relevant standard.
- f. All nuts and bolts shall be made of HDG mild steel.
- g. Bimetallic sleeve/liner shall be 2 mm
- h. The conductor should be tightened by six bolts. Conductor hold length must not be less than 100mm.
- iv) Wherever necessary bi-metallic strip of standard quality shall be used to avoid galvanic isolation.
- v) The surface of clamps to be tightened by six bolts should be flat in shape so that it may be possible to open the nuts and bolts by normal spanners. Therefore, any type of groove in the clamp body for fixing of nuts should be avoided.
- vi) The portion of clamp to hold the conductor should be flat and straight and not zigzag in construction, at both the sides, so that heating of clamp by throttling action of current may be avoided.
- vii) Space of at least 50% of diameter of nuts should be available after the hole at both the sides of conductor holding portion for better mechanical strength.
- viii) Size of terminal connector for which the clamp is designed and also rated current under site conditions shall be embossed / punched on each part of clamps except hardware.

5.8 ISOLATOR AND EARTH SWITCH OPERATION:

- 5.8.1 Each 36 KV isolator switch shall be equipped with local manual operating device with worm & reduction gear. It shall be possible to pad lock the manual operating handle both in the open and close positions of the switches. Additional castle type outer lock shall be provided on the manual operating handle and control cubicle as to prevent the operation of isolator manually & locally when the corresponding circuit breaker is ON'. The earth switch may be local manual operated by separate mechanism without worm & reduction gear. Operating mechanisms for main switch & earth switch should be provided with flexible copper strips for earthing of handle.

5.8.2 OPERATING MECHANISM:

All Isolators and earthing switches shall have separate dependent manual operation. The operating mechanism shall provide quick, simple and effective operation.

The design of manual operation shall be such that one man shall be able to operate the isolator without undue effort and isolator should open/close with about 20 revolutions of crank.

In case of any operational problem in worm and reduction gear assembly, suitable arrangement should be incorporated for manual operation of main switch, after by passing worm/reduction gear assembly. To hold operating pipe of main switch in position, suitable guide should be provided to arrest movement in case of by passing of worm & reduction gear assembly.

The earth switch shall have simple manual operating mechanism. In the earth switch only banging type feature is required, therefore the operating mechanism should be such that the blade goes very smoothly in the fixed contact. There should not be any jerk during operation. The earth switch plate should not move due to gravity.

In the rotating insulator, the design should be such that the shaft length is enough to accommodate the locknut in a proper manner.

The isolators and isolator with earth switches inclusive of their operating mechanism should be such that they cannot come out of their open or closed positions by gravity, wind pressure, vibrations reasonable shocks, or accidental touching of connecting rods of the operating mechanism. Isolators and earth switches should be capable of resisting in closed position, the dynamic and thermal effects of maximum possible, short circuit current at the installation point. They shall be so constructed that they do not open under the influence of the short circuit current.

The operating mechanism should be robust constructions, easy to operate by a single person and conveniently located for local operation in the switchyard.

ON/OFF marking will be given on operating mechanism of main switch and earth switch. Direction will also be indicated. Proper locking arrangement with lock & key of operating handle in ON & OFF position should be provided.

Limit switches for control shall be fitted on the isolator shaft within the cabinet to sense the open and close positions of the isolators and earth switches. It shall not be possible, after final adjustment has been made, for any part of the mechanism to be displaced at any point in the travel sufficient enough to cause improper functioning of the isolator when the isolator is opened or closed at any speed.

All holes in cranks, linkage etc, having moving pins, shall be drilled to fit accurately so as to maintain the minimum amount of slack and lost-motion in the entire mechanism.

5.9 CONTROL CABINET:

The control cabinet of the operating mechanism shall be made out of 12 SWG (2.64 mm thick) sheet steel duly hot dip galvanised or 10 mm thick aluminium plate or casting. The Cabinet shall have adequate channel support to withstand weight of gear. 2 Nos. rectangular frames made of 50x50x6 mm angle shall be provided to fix gear operating box on structure angles 20 x 14 mm slots both in horizontal and vertical direction will be provided on gear operating box support to facilitate adjustment for fixing. Hinged door shall be provided with pad locking arrangement. Sloping rain hood shall be provided to cover all sides. 15 mm thick neoprene or better type of gaskets shall be provided to ensure degree of protection of at least IP 55 as per IS: 2147. The cabinet shall be suitable for mounting on support structure with adjustment for vertical alignment. Details of these arrangements shall be furnished along with the bid.

5.10 GEAR:

The isolators may be required to operate occasionally with considerable long idle intervals. Special care shall be taken for selection of material of gear to meet this requirement. The gear shall be made of aluminium bronze

or any better quality material and lubricated for life with suitable lubricant. Gear operating box should be properly sealed to prevent any leakage of grease / lubricating material. Provision for future lubrication should also be made. The gear box enclosure should be made by casting process and not of sheet steel to provide proper gear alignment. It should be filled with graphite grease or non-hardening grease. Complete details of component, material and grade, lubricant material and grade shall be furnished in the bid.

5.11 PIPES:

Tandem pipes and operating handle shall be class B pipe having at least 24 mm internal diameter. The operating pipe shall also be class B with internal diameter of at least 38 mm. The pipe shall be terminated into suitable universal type joints between the insulator bottom bearing and operating mechanism.

Bushes may be provided on coupling of tandem pipe with insulator rotating base (3 Nos.). Bushes may also be provided on both sides of operating down pipe (2 Nos.) at support clamps. Bushes shall be made by machining process for smooth movement and should have minimum thickness of 2 mm. Bushes should be machined having one side proper collar and other side to be press fitted. Flange type joint should be provided at the bottom and universal coupling at top of down operating pipe to avoid any play during operation.

5.12 BASE CHANNELS:

The isolator shall be mounted on a base fabricated from steel channel section of adequate size not less than 100x50 mm to withstand total weight of Isolator and insulators and also all the forces that may encountered by the isolator during service. The strengthening / jointing of base channels should be made by same size channels, to eliminate any vibrations during operations. Mounting plates for insulators shall be big enough to properly accommodate insulator metal parts (Base flanges). For fixing of bearing housing one M.S. plate of 8 mm thickness should be welded on mounting channels, covering entire width of mounting channel base. The M.S. Plate will have slotted round hole in the middle for accommodating bearing assembly. The steel channel in each phase shall be mounted in vertical position and over it two mounting plates at least 8 mm thick with suitable nuts and bolts shall be provided for minor adjustment at site. Suitable marking on various parts including mounting channel should be provided for proper identification.

5.13 TERMINAL BLOCK & WIRING:

Each operating mechanism shall be provided with 1100 V grade stud type terminal block having washers, nuts & check nuts. All auxiliary switches, interlocks and other terminals shall be wired up to terminal block. The terminal block shall have at least 20% extra terminals. All wiring shall be carried out with 1100 V grade insulated 2.5 mm² copper wires.

5.14 INTERIOR ILLUMINATION:

A switch, HRC fuse and holder suitable for a 230V lamp shall be provided in the mechanism box of isolator and operating mechanism box of earth switch.

5.15 SPACE HEATERS:

Space heater thermostatically controlled, suitable for single phase 230V AC supply shall be provided for operating mechanism to prevent condensation. A switch and fuse/link shall be provided in the operating mechanism.

5.16 POWER SOCKET:

A single phase 230 V 15A power socket and switch shall be provided in the Operating mechanism.

5.17 ACCESSORIES:

The accessories to be provided on the isolator shall include but not limited to the following:

5.17.1 POSITION INDICATOR:

A position indicator to show whether the isolator is in ON or OFF position

5.17.2 COUNTER BALANCE SPRINGS:

Counter balance springs, cushions etc., shall be provided to prevent impact at the end of travel both on opening and closing of the isolator. The springs shall be made of durable and non-rusting type alloy.

5.18 NAME PLATE:

Isolator and Earth switches and their operating devices shall be provided with a name plate. The name plate shall be weather proof and corrosion proof. It shall be mounted in such a position that it shall be visible in the position of normal service and installation. It shall carry the following information duly engraved or punched on it.

Isolator Base

Name of utility : OPTCL

Name of Manufacturer :

P.O. No. :

Type Designation :

Manufacturer's serial number :

Rated voltage :

Rated normal current :

Rated short time current (rms) :

and duration :

Rated short time peak current (kAp) :

Weight :

Earth Switch

Name of utility : OPTCL

Name of Manufacturer :

P.O. No. :

Type Designation :
 Manufacturer's serial number :
 Rated voltage :
 Rated normal current :
 Rated short time current (rms) :
 and duration :
 Rated short time peak current (kAp):
 Weight :

Operating Device

Name of utility : OPTCL
 Name of Manufacturer :
 P.O. No. :
 Type Designation :
 Reduction gear ratio :
 Space Heater :
 Rated voltage and power Auxiliary contacts
 i. Rated current (Amps) :
 ii. Time constant (ms) :
 iii. No. of contacts used (NC & NO) :
 iv. No. of free contacts (NC & NO) :
 Terminal blocks and wiring
 i. Rated current :
 ii. Voltage grade and type :

5.19 SIGNALLING:

Signalling of the close position shall not take place unless the movable contact has set in a position in which the rated normal current, the peak withstand current and the short time withstand current can be carried safely.

Signalling of the open position shall not take place unless the movable contact has reached the position such that the clearance between the moveable and fixed contacts is at least 80% of the isolating distance.

5.20 EARTHING:

Flexible copper connections shall be provided between rotating earth blades and the frame which shall have a cross-section of at least 50 mm² and shall be tinned or suitably treated against corrosion.

The frame of each isolator and earth switch shall be provided with two reliable earthing terminals for connection to the earthing conductor/flat and also clamping screws suitable for carrying specified short time current. Flexible ground connections shall be provided for connecting operating handle to the earthing flat. The diameter of clamping screw shall be at least 12 mm. The connecting point shall be marked with earth symbol.

5.21 DESIGN AND CONSTRUCTION:

Full particulars of design, manufacture, jig template and quality control devices developed for manufacture of the equipment offered in respect of but not limited to the following, shall be furnished with drawings and descriptions along with the tender.

- i. Contacts, material, current density etc.
- ii. Design of contact pressure.
- iii. Contact support and fixing arrangement on isolators.
- iv. Turn and twist mechanism, clamps, locks etc.,
- v. Bearings, housing of bearings, bushes etc.,
- vi. Balancing of heights, Coupling pipes, joints, connection adjustments.
- vii. Base plates.
- viii. Down pipe guides and joints.
- ix. Brass bushes and bearings at various joints.
- x. Operating mechanism, type of gear, limit switch, aux. switch, timers, size and thickness of box, degree of protection, gland plate, gland etc.,
- xi. Nuts, bolts and fasteners.
- xii. Interlocking devices.

5.21.1 FASTENERS:

Nuts, bolts and washers of 5/8" and higher size shall be hot dip galvanised. The bolts used on tapped holes of insulator cap shall be galvanised by centrifuge process to avoid excess deposition of zinc on threads. Nuts, bolts and washers of less than 5/8" size shall be of stainless steel when used on live parts and nickel plated brass in other parts.

5.21.2 CONTACTS:

Contacts shall be made out of hard drawn electrolytic grade copper. Arcing contacts wherever provided shall close first and open last. The contacts surface shall be silver plated. Fabrication of contact shall be made with

suitable jig to avoid deviations during production. Details of size and shape of contacts, springs, back plate, fixing arrangements design of contact pressure, life of contacts, limit of temperature rise etc., shall be furnished along with the tender. The moving contacts of tubular section shall be so dimensioned as to carry the rated current.

5.21.3 MOUNTING OF CONTACTS:

The contacts shall rest on a brass block and with initial tension. Suitable device shall be provided to prevent dashing. Fabrication, welding etc., shall be done in suitable jig to avoid deviations during production.

5.21.4 TERMINAL PAD:

The terminal pad shall be suitable for connection to aluminium terminal connector through bimetallic plate wherever necessary. It shall be made out of electrolytic copper heavily silver plated. Dimensions of the terminal pad shall be furnished with the Bid

5.22 INTERLOCKS AND EARTH SWITCHES:

i) Line earth switches shall consist of three earthing links per isolator which will normally rest against the frame when the connected isolator is in closed position. The earthing links for the three phases shall be mechanically linked to a coupling shaft which shall be capable of being fitted on either side of the isolator. Earth switch shall be mechanically interlocked with the main switch so that is possible to close or open the earth switch only when the main switch is in the open position & its closing operation shall not be possible. Therefore, the earthing switches should be provided with counter balance weight so that the earth switches do not fall due to gravity and it moves very smoothly in upward direction i.e. against gravity. The length of lever and counter weight should be selected carefully so that earth switch is in horizontal position in fully opened condition. Each earthing switch shall be designed to withstand electrodynamic stress due to currents up to 50 kA (peak) as per IEC recommendations. The contacts shall be of silver plated copper only.

ii) All shafts, couplings etc shall be galvanised. Flexible copper connectors of at least 50sq.mm cross-section shall be provided between the rotating shafts and the frame work.

5.23 BEARINGS:

The design and construction of the various bearings shall embody all the features required to withstand climatic conditions specified, so as to ensure dependable and effective operation even after long periods of in-action of these isolators and switches. Bearing housings should be weather proof. Facilities should be provided for lubrication of bearings. The location and number of bearings provided for reducing friction shall be clearly intimated along with suitable drawings.

The bearing housing shall be made of gravity die-cast aluminium with smooth surface suitably machined for sealing the bearings. Each bearing assembly shall have two nos. (Taper roller thrust and ball) bearing with adequate shaft diameter. A minimum distance of 100 mm between thrust and ball bearings shall be provided to avoid wobbling during operation. The bearings shall be of reputed make e.g. SKF, HMT, NBC, and TATA & lubricated for life. All other friction locations shall be provided with suitable bearings/ stainless steel or brass bushes. Complete details of arrangement offered shall be furnished.

5.24 SUPPORTING STRUCTURE:

The supporting structure shall be supplied by the purchaser. The successful bidder shall provide all load details for design and fabrication of the structure for mounting of isolator and earth switch.

5.25 DESIGN, MATERIAL AND WORKMANSHIP:

The successful bidder shall assume full responsibility for co-ordination and adequate design. All materials used in the construction of the equipment shall be of the appropriate class, well finished and of approved design and name. All similar parts should be accurately finished and inter-changeable.

5.26 PAINTING, GALVANISING AND CLIMATE PROOFING:

All interiors and exteriors of control cabinets shall be thoroughly cleaned to remove all rust, scales, corrosion, grease and other adhering foreign matter and the surfaces treated by recognized phosphating (e.g. seven tank phosphating sequence). After such preparation of surfaces, two coats of zinc oxide primer shall be given by suitable staving and air drying before final painting. Colour of the final paints shall be of shade No. 697 of ISI i.e. epoxy light gray. The finally painted cubicle shall present aesthetically pleasing appearance free from any dent or un-even surface. Paint inside the metallic housing shall be of anti-condensation type and the paint on outside surfaces shall be suitable for outdoor installation. All components shall be given adequate treatment of climate proofing as per IS-3202 or equivalent international standard so as to withstand corrosive and severe service condition.

All ferrous parts shall be heavily hot dip galvanised. Bolts, nuts, pins and washers, etc. used on the isolators shall also be galvanised. All the nuts, bolts and washers in current carrying parts shall also be of hot dip galvanised. Special attention shall be paid to give tropical treatment to all the equipment as it will be subjected during service to extremely severe exposure to atmospheric moisture and to long period of high ambient temperature. All current carrying parts shall be of non-ferrous metal or alloys and shall be designed to limit sharp points edges and similar sharp faces.

6.0 TESTS:

6.1 TYPE TEST:

All the equipment offered, shall be fully type tested as per IS 9921- Part 4 (IEC62271-102). Copy of test reports shall be enclosed with the bid. For any change in the design/type already type tested and the design/type offered against this bid, OPTCL reserves the right to demand repetition of same or all type tests without any extra cost. The tests should have been carried out in an independent NABL approved laboratory (based on ISO/IEC). In the absence of any one of the following, the bid is liable to reject.

- Short time withstands & peak withstand current test for isolator
- Power frequency (DRY & WET), Lightning impulse dry withstand
- Radio Interference Voltage(RIV) test
- Mechanical endurance Test & Terminal Load test
- Degree of Protection (IP-55)
- Temperature rise test

- Blocked rotor test

During type tests the isolator shall be mounted on its own support structure or equivalent support structure and installed with its own operating mechanism to make the type tests representative. Drawing of equivalent support structure and mounting arrangements shall be furnished for purchaser's approval before conducting the type tests.

The type tests shall be conducted on the isolator along with approved insulators and terminal connectors.

Mechanical endurance test shall be conducted on the main switch as well as earth switch of one isolator of each voltage class of M2 class (10000 operations) as per IEC 62271-102 which shall be tested at any NABL accredited independent laboratory like CPRI/ERDA.

6.2 ACCEPTANCE & ROUTINE TESTS:

a) The manufacturer shall carry out all acceptance and routine tests as stipulated in the relevant Indian Standards or equivalent International Standards in presence of Purchaser's representative.

b) Immediately after finalisation of the programme of type / acceptance / routine testing, the manufacturer shall give sufficient advance intimation to OPTCL, to enable him to depute his representative for witnessing the tests.

The test certificates of various raw materials and bought out items including but not limited to the following shall be furnished at the time of routine tests.

- Chemical analysis of copper along with a copy of excise certificate indicating genuine source of procurement of electrolytic grade copper.
- Aluminium extrusions
- Aluminium ingots & castings
- Fasteners
- Insulators
- Motors
- Gears
- Auxiliary switch
- Limit switch
- Overload/Single phase preventer
- Interlocking device
- Terminal block

7.0 INSPECTION:

i. OPTCL shall have access at all times to the works and all other places of manufacture, where the isolators are being manufactured and the Bidder shall provide all facilities for unrestricted inspection, raw materials, manufacture of all the accessories and for conducting necessary tests as detailed herein.

ii. The successful Bidder shall keep the Purchaser informed in advance of the time of starting and of the progress of manufacture of equipment in its various stages, so that arrangements could be made for inspection.

iii. No material shall be dispatched from the point of manufacture unless the material has been satisfactorily inspected and tested.

iv. The acceptance of any quantity of the equipment shall in no way relieve the successful bidder of his responsibility for meeting all the requirements of this specification and shall not prevent subsequent rejection if such equipment are later found to be defective.

8.0 QUALITY ASSURANCE PLAN & STAGE INSPECTION:

The successful bidder shall ensure that for the purpose of supply of equipment, the manufacturer will have to follow strict quality assurance programme, which will include thorough verification of samples of critical assemblies and accessories, verification of sources of raw materials, detailed verification of drawing & design, checking up of relevant calculations, stage inspections at various critical stages of manufacture and minor modifications consequent to such stage inspections as per our requirements and all other related requirements, which have generally been brought out in bidding documents and the detailed contract. It is expected that bidder would be very serious and prudent in meeting these requirements without any loss of time, so that supply of equipments in line with quality assurance programme is ensured within targeted schedule.

OPTCL reserves the right to specify various stages for stage inspections and also for manufacture of a proto type unit for inspection & testing, before according clearance for bulk manufacturing.

The bidder shall ensure that manufacturer must establish that they are following a proper quality assurance programme for manufacture of offered equipments.

The bidder shall ensure that manufacturer invariably furnish following information:-

- i. Statement giving list of important raw materials, names of sub supplier for the raw material, list of standards according to which the raw material are tested, list of tests normally carried out on raw material in presence of manufacturers representative, copies of test certificates.
- ii. Information and copies of test certificates as in (i) above in respect of bought out items.
- iii. List of manufacturing facilities available.
- iv. Levels of automation achieved and list of areas where manual processing exists.
- v. List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspection.
- vi. Special features provided in the equipment to make it maintenance free.
- vii. List of testing equipment available with the manufacturer for final testing of equipment specified and test plant limitations, if any vis-à-vis type, special, acceptance and routine tests specified in the relevant Indian Standards or equivalent international standard. These limitations shall be very clearly brought out in schedule of deviations from specified test equipments.

The successful bidder shall arrange following information to the OPTCL within 30 days of award of Contract.

- i. Quality Assurance Plan (QAP) withhold points for OPTCL's inspection.

The quality assurance plans and holds points shall be discussed between OPTCL and Bidder before the QAP is finalized.

The successful Bidder shall also ensure that the manufacturer submits the routine test certificates of bought out items and for raw material at the time of routine testing of the fully assembled equipment.

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9.0 DOCUMENTATION:

9.1 All drawings shall conform to latest version of international standards organization (ISO) 'A' series of drawing sheet/Indian Standards Specification IS-11065. All dimensions and data shall be in S.I. Units.

9.2 LIST OF DRAWINGS AND DOCUMENTS:

The Bidder shall furnish four sets of following details and drawings along with his bid

i. Complete assembly drawing showing plan and elevation views of the isolator, complete with details of operating mechanism, mounting dimensions etc.

ii. Sketches and descriptive details of:

- a. The outline dimensions of the isolating and earth switches.
- b. Details of main contacts.
- c. The mechanical interlock between earth and isolating switches.
- d. The details of fixed and moving contacts and the arrangement of pressure relief.
- e. Turn and Twist mechanism.
- f. Bearing assembly.
- g. Terminal connectors.
- h. Name plates to be provided.
- i. Operating mechanism, type of gear, size & thickness of box, gland plate, gland etc.

iii. Drawings with details to substantiate the suitability of the jaw design.

iv. Type Test reports in case the equipment has already been type tested.

9.3 The Supplier shall within two weeks of placement of order, submit four sets of final versions of all the above drawings for Purchaser's approval. The Purchaser shall communicate his comments/approval on the drawings to the Supplier within reasonable time. The Supplier shall, if necessary, modify the drawings and resubmit the modified drawings for Purchaser's approval within two weeks from the date of Purchaser's comments. After receipt of Purchaser's approval, the Supplier shall within three weeks submit four prints for purchaser's use.

9.4 The Bidder before commencement of supply shall submit two sets of the type test reports, duly approved by the Purchaser. Two copies of acceptance and routine tests certificates, duly approved by the Purchaser shall accompany the dispatched consignment.

- 9.5 The manufacturing of the equipment shall be strictly in accordance with the approved drawings and no deviation shall be permitted without the written approval of the Purchaser. All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawing shall be at the Bidder's risk.
- 9.6 Two copies of manual of operation, maintenance and erection in English Language, for each type and rating of equipment supplied shall be submitted by the supplier. The manual shall contain all the drawings and information required for erection, operation and maintenance of the equipment. The manual shall also contain a set of all the approved drawings, type test reports etc.
- 9.7 Approval of drawings/work by OPTCL shall not relieve the Bidder of his responsibility and liability for ensuring correctness and correct interpretation of the latest revision of applicable standards, rules and codes of practices. The equipment shall conform in all respects to high standards of engineering, design, workmanship and latest revisions of relevant standards at the time of ordering and Purchaser shall have the power to reject any work or material, which in his judgment is not in full accordance there with.

10.0 PACKING AND FORWARDING:

- 10.1 Bidder shall ensure that the equipment shall be packed in crates suitable for vertical / horizontal transport, as the case may be and suitable to withstand handling during transport and outdoor storage during transit.

11. DEVIATION FROM TECHNICAL PARTICULARS:

No deviation from technical particulars of equipment and materials will be allowed, which may please be noted.

12. GUARANTEED TECHNICAL PARTICULARS:

The Bidder shall submit the Guaranteed Technical Particulars as per Appendix 2.

APPENDIX 1

PRINCIPAL PARAMETERS

Sl.No	Technical Parameter	
1.	Rated Frequency (Hz)	50
2.	System Neutral Earthing	Effectively Earthed
3.	No. of Phases (Poles)	3
4.	Temperature Rise	As per relevant IS/IEC
5.	Safe Duration of overload	
	a) 150% of rated current	5 minutes
	b) 120% of rated current	30 minutes
6.	Rated voltage /Highest system voltage (kV)	33/36
7.	Type of disconnecter (AB)	HDB
8.	Rated normal current (Amps)	1250
9.	Rated short time withstand current (kA)	31.5KA for 1s
10.	Rated dynamic withstand current (kA)	80
11.	Rated short circuit making current of EB (kA peak)	80
12.	Basic insulation level:	
	i) Lightning impulse withstand voltage (+ ve or -ve polarity)	
	a) To earth (kVp)	170
	b) Across isolating distance one terminal subjected to lightning impulse (kVp) and opposite terminal subjected to power frequency (kV rms) voltage	195
	ii) Rated 1 minute power frequency withstand voltage (kV rms)	
	a) To earth and between poles	70
	b) Across isolating distance	80
13	Minimum creepage distance of support and rotating insulator (mm)	1116
14	Phase to Phase spacing for installation (mm)	1500
15	Minimum clearances:	
	a) Phase to earth (mm)	480
	b) Phase to Phase (Across the same pole) (mm)	1500
16	Bus Bar height from plinth level (mm)	3700 Check with GA
17	Rating of auxiliary Contacts	2A, 220V D.C. circuit with a time constant of not less than 20 ms.
18	Rated mechanical terminal load	As per relevant standards
19	Rated magnetizing/ capacitive current make/break (Amps/rms)	0.7Amps at 0.15 P.F

20	Operating mechanism a) Isolator b) Earth switch	Motor Manual
21	Operating time of the Isolator	Shall not exceed 10 seconds

APPENDIX 2

GUARANTEED TECHNICAL PARAMETERS

Sl.No	Description	To be filled by the bidder
1	General	
	a) Name of Manufacturer	
	b) Manufacturer's type designation	
	c) Standard applicable for Isolators and earth switches	
	d) Rated voltage (kV)	
	e) Rated current under site conditions @ 50°C ambient	
	f) Rated frequency (Hz)	
	g) Number of poles	
	h) Whether all 3 poles are ganged	
	i) Phase to Phase spacing	
	j) Type of Installation	
2	Guaranteed rating	
	a) Rated short time current of isolator (kA) and dynamic current (kAp)	
	c) Temperature rise over 50°C ambient temperature corresponding to maximum continuous current (°C)	
3	Dielectric withstand capacity of completely assembled isolator/ isolator and earth switch	
	a) One minute dry power frequency withstand test voltage (kV rms)	
	i. Against ground (kV rms)	
	ii. Across isolating distance (kV rms)	
	b) 1.2/50 μ s impulse withstand test voltage	
	i. Against ground (kVp)	
	c) Total creepage distance to ground (mm)	
4	Operating Mechanism	
	A) For Main Blades	

	a) type	
	b) Manufacturer's Type designation	
	c) Rated torque of the mechanism (Kg-m)	
	B) For Earth Switches	
	a) Manufacturer's Type reference	
	b) Rated torque of the mechanism	
4.1	Interlocks	
	a) Whether mechanical/ Constructional interlock between isolator & earth switch provided	
	b) Details of electrical interlock enclosed for	
	i. Isolator	
	ii. Earth switch	
	c) Arrangement provided to prevent electrical or manual operation unless interlock conditions are satisfied	
	d) Whether interlock coil is continuously rated	
	e) Rated DC control voltage and variation allowed	
	f) Power consumption (W)	
4.2	Controls	
	a) Rated DC control voltage (V)	
	b) Limits of Voltage	
	c) Power consumption of control coils (W)	
5	Constructional features	
	a) Minimum clearance in air	
	i. Between Phases (mm)	
	i. Between live parts to earth (mm)	
	b) Whether position of earth switch can be interchanged at site to either side of pole	
	c) Minimum clearance between live part and earth switch blade throughout the entire operation arc of earth switch (mm)	
	d) Terminal pad details	
	i. Diameter & length	
	ii. Material of pad	
	f) Main contacts	
	i. Type of contacts	
	ii. Contact area (Cm ²)	
	iii. Material of contacts	

	iv. Contact pressure (Kg/cm ²)	
	v. Maximum current density under normal current carrying capacity (A/cm ²)	
	vi. Thickness of silver plating.	
	g) Number of auxiliary contacts on isolator/pole for Owner's use	
	h) Number of auxiliary contacts on earth switch/pole for Owner's use.	
	i) Auxiliary contacts	
	i. Rated voltage(V)	
	ii. Rated continuous Current (A)	
	iii. Rated DC breaking current with 20 rms time constant (A).	
	j) Mounting dimensions isolators	
	i. Distance between supports	
	ii. Top dimensions of support.	
	k) Height from mounting plane to top of terminal stud	
	l) Whether cable glands required included in the scope	
6	Literature	
	a) Type test reports as per IS 9921	
	b) OGA drawings for isolator with & without earth switches.	
	c) Operation manual for isolators	
	d) Details of manually driven mechanism.	
	e) Recommended drawing for mounting details for isolator and drives.	
	f) Leaflets & literature bringing out salient features of equipment offered.	
	g) Details of constructional interlock.	
	Control Cabinet	
1	Manufacturer's name	
2	Indoor / Outdoor application	
3	Standards applicable	
4	Design ambient air temp(°C)	
5	Thickness of sheet steel (mm) and whether cold rolled or hot rolled.	
6	Degree of protection provided.	
7	Bill of material for all the equipment mounted on control cabinet giving the following details:	
	a) Make and type.	

	b) Applicable Standard.	
	c) Voltage rating.	
	d) Current rating.	
	e) Duty class, if applicable.	
	f) Manufacturer's Catalogue No.	
	g) Total heat load of cabinet (for purpose of ventilation requirement).	
8	Colour of finish paint IS : 5	
	a) Outside.	
	b) Inside.	
9	Control wiring	
	a) Size of Conductor	
	b) Conductor Solid/Stranded.	
	c) Number of Strands/Conductor	
10	Terminal blocks	
	a) Make & Type.	
	b) Current rating.	
	i. Power terminals	
	ii. Other terminals	
11	Space Heater Rating at 230 V AC	
12	Control cabinet drawing showing the following a) Outline dimensions floor openings floor / wall / pedestal fixing arrangements weights, b) Front view, inside view showing the mounting arrangement of various equipment	
13	Schematic/wiring diagram of control cabinet enclosed.	
14	Interconnection drawing showing Owner's external cable, connections to the control cabinet enclosed	
15	Type test report to verify degree of protection enclosed.	
16	Details of Terminal rows	
	a) Whether arranged vertical or horizontal.	
	b) Clearance from adjacent components.	
	c) Distance between rows.	
	d) Whether transparent protection cover provided.	
	TERMINALS CLAMPS AND CONNCTORS	
1	Manufacturer's Name	
2	Applicable Standards	

3	Type	
4	Material of connector	
	a) Clamp body	
	b) Bolts & Nuts	
	c) Spring washers	
5	Rated terminal load (kg)	
6	a) Rated terminal load(kg)	
	b) Factor of safety	
7	Minimum thickness of any part (mm)	
8	Weight of clamp complete with hardware (kg)	
9	Type test reports as per IS enclosed	
10	OGA drawing enclosed	
	SUPPORT INSULATOR	
1	Manufacturer's Name	
2	Type	
3	Applicable Standards	
4	i) Height ii) Diameter(Top) iii) Diameter(Bottom)	
5	Total Creepage distance (mm)	
6	Rated Voltage (kV)	
7	Power frequency withstand voltage for 1 min. (kV rms) dry and wet.	
8	1.2/50 micro sec. Impulse withstand voltage(kVp)	
9	Weight (kg)	
10	Cantilever strength (kg)	
11	OGA drawing enclosed	
12	Tensile strength. (kN)	
13	Compression strength. (kN)	
14	Torsion failing load (kN-m)	
15	Bending strength (kN)	
19	Failing load in bending (kN)	

PART-12
33kV CURRENT TRANSFORMER

TECHNICAL SPECIFICATION FOR 33KV CURRENT TRANSFORMER

1.0 SCOPE:

The specification covers the design, manufacture, assembly, inspection and testing at the manufacture's work, packing and delivery F.O.R. (destination) of the outdoor mounted live tank type, single phase, and single unit type current Transformers for protection and metering services in 33kV solidly grounded system.

The current transformers shall be of the outdoor type, single phase, 50 C/S, oil immersed, self-cooled, hermetically sealed and suitable for operating in the tropical conditions with maximum ambient temperature up to 50°C. The C.Ts should be suitable for use in the areas subject to heavy lightning storms and highly polluted conditions.

Followings are the list of documents constituting this specification.

[i]	Technical specification(TS)	
[ii]	Technical Requirements	Appendix I
[iii]	Quantity and Delivery	Appendix II
[iv]	Guaranteed Technical Particulars	Annexure –A
[v]	Calibration Status of testing equipments and meters / Instruments	Annexure – B
[vi]	Check-List towards Type Test Reports	Annexure-C
[vii]	Check-List for Delivery Schedule	Annexure-D
Note :	Annexure- A, B, C & D are to be filled up by the Bidder	

The current transformer shall conform in all respects to high standards of engineering, design, workmanship and latest revisions of relevant standards at the time of offer and purchaser shall have the power to reject any work or material which in his judgment is not in full accordance therewith.

Guaranteed Technical particulars:

- [a] **Bidders are required to quote for 0.2S for 33kV Current transformers of metering cores with the following data / information's etc.**
- [b] Technical literatures, brochures and drawings as per this specification
- [c] Type Test Reports.
- [d] List of orders, executed and User's certificates, failing submission of the above particulars with the offer, the tender may not be considered for evaluation.

2.0 STANDARDS:

Except to the extent modified in the specification, the C.Ts shall conform to the latest editions and amendments of the standards listed hereunder.

Sl. No.	Standard Ref. No.	Title
1	IEC-44	Instrument transformer-measurement of PDS
2.	IEC-60	High Voltage Testing Technique.
3.	IEC-171	Insulation co-ordination
4.	IEC-61869-2:2012	Current Transformers.
5.	IEC-270	Partial Discharge Measurement
6.	IEC-8263	Method for RIV Test on High Voltage Insulators.
7.	IS-335	Insulating oil for Transformers
8.	IS:2071	Method of High Voltage Testing
9.	IS:2099	High Voltage porcelain Bushings
10.	IS:2147	Degree of Protection Provided by Enclosures for Low Voltage Switchgear and Control.
11.	IS:2165	Insulation Co-ordination for equipment of 100kV and above
12.	IS:2705 [Part-I to IV)	Current Transformers
13.	IS:3347	Dimensions of Porcelain Transformer Bushing
14.	IS:5621	Specification for Large Hollow Porcelain for use in Electrical installation.
15.	IS:4201	Application guide for CTS
16.		Indian Electricity Rules, 1956

Current Transformers with the requirements of other authoritative standards, which ensure equal or better quality than the standards, mentioned above, shall also be acceptable, Where the equipment, offered by the supplier conforms to

other standards, salient points of difference between the standards adopted and specified standards shall be brought out in the offer. 4 (four) copies of the reference standards in English language shall be furnished along with the offer.

The supplier is to furnish the latest edition of the standards as mentioned above from SI.1 to SI.15 with their amendments, if any, at their own cost, if required by the Purchaser.

All the above along with amendments thereof shall be read and interpreted together. However, in case of a contradiction between the Technical Specification and any other volume, the provisions of this specification will prevail.

3.0 CLIMATIC & SERVICE CONDITIONS:

The current Transformers are required to operate satisfactorily under the following conditions.

1	Maximum ambient air temperature	50deg C
2	Minimum ambient air temperature	5deg C
3	Average ambient air temperature	32 deg C
4	Maximum Relative Humidity	100%
5	Maximum altitude above mean sea level	Below 1000m
6	Maximum wind speed	50 m/s
7	Isokeraunic level	70 Days/year
8	Seismic level	Zone-3

EARTHQUAKE INCIDENCE:

The current Transformers are to be designed to withstand earthquakes of intensity equivalent to seismic acceleration of 0.3g in the horizontal direction and 0.15g in the vertical direction, where 'g' stands for acceleration due to gravity.

The current Transformers covered under this specification shall be suitable for outdoor installation.

4.0 PUCHASER'S AUXILIARY POWER SUPPLY:

4.1: Following power supplies shall be made available at site.

- (a) A.C. Three phase, 415V, 50HZ earthed
- (b) A.C. Single Phase, 240V, 50HZ earthed.
- (c) 220 V D.C. ungrounded.

All the equipments and devices shall be capable of continuous satisfactory operation on AC and DC supplies of normal voltage mentioned above with the variation given below.

[a]	AC voltage variation	$\pm 10\%$
[b]	Frequency variation	$\pm 5\%$
[c]	Combined voltage and frequency variation	$\pm 10\%$
[d]	DC Voltage Variation	190V to 240V

The supplier shall make his own arrangements for the power supplies other than those specified under clause 4.1 above.

5.0 GENERAL TECHNICAL REQUIREMENTS:

The C.T. shall be of live tank design and shall be so constructed that it can be easily transported to site within the allowable limitation and in horizontal position if the transport limitations so demand.

For compensation of variation in the oil volume due to ambient variation, metal bellows shall be used. Rubber diaphragms shall not be permitted for this purpose.

The C.T. secondary terminals shall be brought out in a weather proof terminal box. The terminal box shall be provided with removable gland plate and gland (s) suitable for 1100 volts grade PVC insulated, PVC sheathed, multicore 4 Sq. mm stranded copper conductor cable. The terminal blocks shall be stud-type or Terminal Block type and provided with ferrules, indelibly marked or numbered. The terminals shall be rated for not less than 10 Amps. The terminal box shall be dust and vermin proof. Suitable arrangements shall be made for drying of air inside the secondary terminal box. The dimensions of the terminal box and its openings shall be adequate to enable easy access and working space with the use of normal tools.

Polarity shall be indelibly marked on each primary and secondary terminal. Facility shall be provided for short-circuiting and grounding of the C.T. secondary terminals inside the terminal box or in Marshalling Box.

The C.T. shall be provided with non-corrosive, legible nameplate with the information, specified in the relevant standards, duly engraved/punched on it.

The current Transformer shall be vacuum filled with oil after processing and thereafter hermetically sealed to eliminate breathing and to prevent air and moisture from entering the tanks. Oil filling and / or sampling cocks, if provided to facilitate factory processing should be properly sealed before dispatching the C.T., The method adopted for hermetic sealing shall be described in the offer

The castings of base, collar etc. shall be die cast and tested before assembly to detect cracks and voids, if any.

The instrument security factor of metering core shall be low enough and not greater than '5'. This shall be demonstrated on all the ratios of the metering core in accordance with procedure, specified in IEC-185 OR IS:2705

Current transformers' guaranteed burdens and accuracy class are to be intended as simultaneous for all cores.

For 36 KV Current Transformers, characteristics shall be such as to provide satisfactory performance in accordance with latest IS & IEC.

Current Transformers shall be designed so as to achieve the minimum risk of explosion in service. The Bidder shall bring out in his offer, the measures taken to achieve this.

PRIMARY WINDING:

- (I) The rated extended primary current shall be 120% on all cores of the C.Ts, specified in tables for highest Ampere & for lowest Ampere it shall be 200%. The offered Primary winding type 33kV class C.Ts, should have been type tested.
- (II) The primary windings of current transformers shall be constructed of high purity, annealed, high conductivity electrolytic copper meeting to the requirements of IEC 28/IS: 2705.

SECONDARY WINDING:

Suitably insulated copper wire of electrolytic grade shall be used for secondary windings. Type of insulation, used shall be described in the offer. The secondary taps shall be adequately reinforced to withstand handling without damage.

The rating of the Current Transformer's secondary winding shall be 1 (One) Amp. The secondary terminals shall be brought out in a compartment for easy access.

PRIMARY TERMINALS:

The primary terminals shall be heavily tinned electrolytic of 99.9% conductivity. The minimum thickness of tinning shall be 1.5 microns.

SECONDARY TERMINALS:

- (I) Secondary terminal studs shall be provided with at least three nuts and adequate plain and spring washers for fixing the leads. The studs, nuts and washers shall be of brass, duly nickel-plated. The minimum outside diameter of the stud shall be 6 mm. The length of at least 15 mm shall be available on the studs for

inserting the leads. The horizontal spacing between the centers of the adjacent studs shall be at least 1.5 times the outside circum-dia of the nuts.

- (II) The current transformer shall be provided with suitable test tap for measurement of capacitance, tan delta as well as partial discharges. Provision shall be made on a screw cap for solid and secured earthing of the test tap connection, when not in use. A suitable caution plate shall be provided duly fixed on the cover of the secondary terminal box indicating the purpose of the test tap and the necessity of its solid earthing as per prescribed method before energizing the Current Transformer.
- (III) The secondary terminals shall be provided with shorting arrangements.

CORE:

Each core of the Current Transformer shall be of torroidal shape. Core laminations shall be of cold rolled grain oriented silicon steel or other equivalent alloys of low hysteresis and eddy current losses, high permeability to ensure high accuracy at both normal and over-current conditions. The core material, thickness of lamination, the relevant graphs showing the characteristics of the core material shall be submitted along with the offer.

TANK:

- (I) Both expansion chambers and the tanks of the Current Transformers shall be made up of high quality stainless steel for Bellow & Tank shall be of high quality Aluminum Alloy, which should be able to withstand full vacuums and pressure occurring during transit and thermal and mechanical stresses resulting from maximum short circuit current during operation.
- (II) The metal tanks shall have bare minimum number of welded joints so as to minimize possible locations of oil leakage. Welding in horizontal plane is to be avoided as welding at this location may give way due to vibrations during transport resulting in oil leakage. Supplier has to obtain specific approval from purchaser for any horizontal welding used in the bottom tank.

SECONDARY TERMINAL BOX:

- (I) Secondary Terminal Boxes shall be of Aluminium weather proof with a rating not less than IP 55.
- (II) All secondary terminals shall be brought out in a compartment on the same side of each current transformer for easy access.
- (III) For 33kV CTs, all the ratios should be achieved through secondary tapping(s) only. The primary can be bar/wound type.
The terminal box shall be provided with a removable cable gland plate at bottom for mounting cable glands for 1.1kV PVC sheathed 4 x 4 Sq. mm stranded copper conductor cables.

- (IV) The terminal box shall be provided with a door in front so as to have easy access of secondary terminals. The door shall have a sealing / locking arrangement and shall be suitable to prevent penetration of moisture and rainwater.
- (V) All terminals shall be clearly marked with identification number to facilitate connection to external wiring.

PORCELAIN HOUSING:

- (a) The housing shall be made up of homogeneous, vitreous porcelain of high mechanical and dielectric strength; Glazing of porcelain shall be of uniform brown or dark brown colour with a smooth surface, arranged to shed away rain water or condensed water particles (fog.) The details of location and type of joint, if provided on the porcelain, shall be furnished by the Bidder along with the offer.
- (b) The bushings of the Current Transformers shall conform to the latest edition of IS: 2099. The hollow porcelain insulator shall conform to the latest edition of IS: 5621.
- (c) The insulators shall be cemented with Portland cement to the flanges resulting in high mechanical, tensile and breaking strength.
- (d) The bushings shall have ample insulation, mechanical strength and rigidity for the condition under which they shall be used and shall be designed to prevent accumulation of explosive gases and provide adequate oil circulation to remove the internal heat.
- (e) Cast metal end caps for the bushings shall be of high strength, hot dip galvanized malleable iron. They shall have smooth surface to prevent discharge-taking place between the metal parts and porcelain as a result of ionization.
- (f) The insulation of bushings shall be coordinated with that of the current transformer such that the flashover, if any, will occur only external to the Current Transformer.
- (g) Oil level gauge and convenient means of filling, sampling and draining of oil should be provided.
- (h) End shields should be provided for distribution of stresses.
- (i) Corona shields for bushings, if required should be provided.

INSULATING MEDIUM. (OIL):

The quantity of insulating oil for the filling and the complete specification of the insulating oil shall be stated. The oil shall comply in all respects with the provisions of latest edition of IS: 296. The current Transformers shall be supplied, filled with purified oil completely.

PREVENTION OF OIL LEAKAGE AND ENTRY OF MOISTURE:

The supplier shall ensure that the sealing of the Current Transformer is properly achieved. In this connection, the arrangement provided by the supplier at various locations including the following ones shall be described, supported by sectional drawings.

- (a) Locations of emergence of primary and secondary terminals.
- (b) Interface between porcelain housing and metal tank/s
- (c) Cover of the secondary terminal box.

Nuts and bolts or screws, used for fixation of the interfacing porcelain bushings for taking out terminals shall be provided on flanges, cemented to the bushings and not on the porcelain.

For gasketed joints, wherever used, nitrile butyl rubber gaskets shall be used. The gasket shall be fitted in properly machined groove with adequate space for accommodating the gasket under compression.

FITTINGS AND ACCESSORIES:

Fittings and accessories, listed below shall be supplied with each Current Transformer. Any fitting, required essential other than those listed below shall also be supplied along with each Current Transformer without any extra cost to the purchaser:

- (a) Oil level gauge.
- (b) Oil filling hole and cap.
- (c) Phase terminal connectors.
- (d) Lifting lugs for core and windings, bushings and complete Current Transformers.
- (e) Tank earthing pads/terminals with necessary nuts, bolts and washers for connecting to purchaser's earth strip.
- (f) Name / Rating plate.

(A) OIL LEVEL GAUGE:

An oil level gauge shall be provided to indicate the oil level in the Current Transformer. This gauge shall be mounted in such a way that the oil level can be seen from ground level. If metal bellow is used, a ground glass window shall be provided to monitor the position of the metal bellow. The metal below shall be tested in accordance with relevant standards. The details shall be to the approval of the purchaser.

(B) OIL DRAIN COCK:

An oil drain cock along with a stop cock shall be provided in the bottom flange so as to permit taking of oil samples for testing, if required.

EARTHING:

Metal tank of each Current Transformer shall be provided with two separate earthing terminals for bolted connection to 50mm X 6mm flat, to be provided by the purchaser for connection to station earth-mat.

LIFTING ARRANGMENT:

The Current Transformer shall be provided with suitable lifting arrangement to lift the entire unit. The lifting arrangement shall be clearly shown in the general arrangement drawing. Lifting arrangement (lifting eye) shall be positioned in such a way so as to avoid any damage to the porcelain housing or the tanks during lifting for installation / transport. Necessary string guides shall be offered which shall be of removable type.

NAME PLATE & MARKING:

The Current Transformer shall be provided with non-corrosive, legible name plate with the information specified in relevant standards, duly engraved/punched on it.

A schematic drawing indicating the connections shall be provided in the interior of the Terminal box.

TERMINAL CONNECTORS:

All the Current Transformers shall be provided with bimetallic solderless clamp type, rigid type terminal connectors, suitable for

Sl. No.	CURRENT TRANSFORMER.	Terminal connector.
33kV(0.2s class)		
i	800-400-200/1-1-1	ACSR 'TWIN MOOSE' conductor

Each terminal connector shall be of universal type, suitable for both horizontal and vertical connections to the transmission line conductors / station bus bars.

Terminal connectors shall be manufactured and tested as per IS: 5561.

All castings shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be blurred and rounded off.

No part of a clamp shall be less than 10mm thick.

All ferrous parts shall be hot-dip galvanized conforming to relevant standard.

For bimetallic connectors, copper alloy linear of minimum thickness of 2 mm shall be cast integral with aluminum body.

All current carrying parts shall be designed and manufactured to have minimum contact resistance.

Connectors shall be designed to be corona free in accordance with the requirements, stipulated in IS: 5561.

6.0 TESTS:

TYPE TESTS & SPECIAL TESTS: - (As per latest IEC & ISS).

The current transformers, offered should have been subjected to the following type tests and Special Tests in Government approved test laboratory. The bidder shall furnish type test and Special Tests reports along with the offer for the offered CTs. For any change in the design/type already type tested and the design/type offered against this specification, the purchaser reserves the right to demand repetition of some or all type & special tests without any extra cost to OPTCL in the presence of OPTCL's representative(s) at the cost of the supplier.

- (a) Multiple chopped lightning impulse test.
- (b) High Voltage power frequency wet withstand voltage Test.
- (c) Short time current test.
- (d) Temperature rise test.
- (e) Determination of errors or other characteristics according to the requirements of the appropriate designation and accuracy class as per individual parts of IS: 2705.
- (f) Instrument Security Factor Test.
- (g) IP-55 Test on Secondary Terminal Box.

The below tests are required to be carried out at least in one CT per LOT in the

factory during Acceptance test. These tests will be conducted on one randomly selected unit among the lot offered for inspection and these test will be conducted after HV test only.

- **The** Thermal stability test.
- Thermal Co-efficient test.
- Temperature rise test.
- BDV, Tan delta, Water content, Sp resistance tests of oil.

Note: Power Oil Manufacturer report shall be submitted for Viscosity Test & Total Acidity Test:

- Lightning Impulse Test, switching Impulse Voltage test and High Voltage power frequency wet withstand voltage Tests should have been carried out on the same current transformer.
- After the current transformers have been subjected to lightning Impulse Test, and High Voltage power frequency wet withstand voltage tests, these must have been subjected to all the routine tests as per IS: 2705 (Part-I to IV).

ROUTINE TESTS:

The following routine tests shall be conducted on each Current Transformer in the presence of OPTCL's representative(s) for which no charges will be payable by OPTCL. No sampling will be allowed.

- (i) Appearance and Dimensional Check.
- (ii) Verification of Terminal Marking and polarity.
- (iii) Verification of all individual parts / components of the Current Transformer so as to ensure to have complied the above specification.
- (iv) Measurement of Insulation Resistance.
- (v) Power Frequency Dry withstanding Test on Primary and Secondary winding including primary intersections.
- (vi) Over – Voltage Interturn test.
- (vii) Knee point voltage and Excitation current measurement for 'PS' class cores.
- (viii) Secondary winding resistance measurement.

- (ix) Determination of errors.
- (x) ISF Test.
- (xi) Leakage Test.
- (xii) Magnetization Characteristics of the Current Transformers.
- (xiii) Turn ratio error on 'PS' class cores.

7.0 INSPECTION:

The purchaser shall have access at all times to the works and all other places of manufacture, where the Current Transformers are being manufactured and the supplier shall provide all facilities for unrestricted inspection of the supplier's works, raw materials, manufacture of all the accessories and for conducting the necessary tests.

The supplier shall keep the purchaser informed in advance of the time of starting and of the progress of manufacture of equipment in its various stages so that arrangement could be made for inspection.

No material shall be dispatched from its point of manufacture unless the material has been satisfactorily inspected, tested and dispatch clearance Issued. However, the purchaser reserves the right to alter the dispatch schedule, attached to this specification without any extra financial liability to OPTCL.

The acceptance of any quantity of equipment shall in no way relieve the supplier of his responsibility for meeting all the requirements of this specification and shall not prevent subsequent rejection, if such equipment are found to be defective.

8.0 QUALITY ASSURANCE PLAN:

The Bidder shall invariably furnish following information along with his offer.

- (i) Statement giving list of important raw materials, names of sub-suppliers for the raw materials, list of standards, according to which the raw materials are tested, list of tests, normally carried out on raw material in presence of Bidders' representative, copies of test certificates.
- (ii) Information and copies of test certificates as in (i) above in respect of bought out items.
- (iii) List of manufacturing facilities available.
- (iv) Level of automation achieved and list of areas where manual processing exists.

(v) List of areas in manufacturing process where stage inspections are normally carried out for quality control and details of such test and inspections.

(vi) Special features provided in the equipment to make it maintenance free.

(vii) List of testing equipments, meters available with the Bidder for final testing of equipment specified and test plant limitation, if any, Vis-à- Vis the type, acceptance and routine tests, specified in the relevant standards. These limitations shall be very clearly brought out in the offer.

(viii) All the testing equipments, meters etc, should have been calibrated in a Government approved laboratory. The Bidder must submit the list of testing equipments and meters test-wise as per Annexure – B of the Technical Specification.

The supplier shall within 30 days of placement of order submit the following information to the purchaser.

- (i) List of raw materials as well as bought out accessories and the names of the materials as well as bought-out accessories and the names of sub-suppliers, selected from those, furnished along with the offer.
- (ii) Type Test Certificates of the raw material and bought out accessories.
- (iii) Quality Assurance plan (QAP) with hold points for the purchaser's inspection. The QAP and hold points shall be discussed between the purchaser and the supplier before the QAP is finalized.

The supplier shall submit the routine test certificate of bought-out items and raw materials at the time of acceptance testing of the fully assembled equipment.

9.0 DOCUMENTATION:

All drawings shall conform to relevant Indian Standard as per relevant IS. All drawings shall be in ink and suitable for microfilming. All dimensions and data shall be in S.I. units.

The supplier shall furnish the following drawings/documents along with his offer for 0.2S accuracy class metering core CTs in form of scanned copy.

- (a) General outline and assembly drawings of the Current Transformers.
- (b) Sectional views showing.
 - (i) General constructional features.

- (ii) Materials / gaskets / sealing used.
- (iii) The insulation of the winding arrangement, method of connection of the primary / secondary winding to the primary / secondary terminals etc.
- (c) Schematic drawing
- (d) Rating and Diagram plate.
- (e) Secondary Terminal Box.
- (f) Assembly Sectional view of Primary Terminal
- (g) Assembly drawing for secondary terminal.
- (h) The detailed dimensional drawing of Porcelain Housing such as ID, OD, thickness and Insulator details such as height, profile of petticoats, angle of inclination and gap between successive petticoats, total creepage distance etc.
- (i) Sectional view of Pressure Release device.
- (j) Drawing showing details of Oil level Indicator.
- (k) All type and special test reports relating to tests, as mentioned at CI.No. 6.1 of this Technical Specification.
- (l) Ratio and phase angle error curves for CTS.
- (m) Magnetization characteristic curves such as B-H curves and sp.lossvs. flux density curves.
- (n) Drawings for Terminal Connector.

10.0 TEST REPORTS:

- (i) The type test and special test reports shall be furnished to the purchaser with the tender offer for CTs (having PX class & 0.2S class).
- (ii) Copies of acceptance test reports and routine test reports shall be furnished to the purchaser. One copy will be returned, duly certified by the purchaser and only thereafter shall the materials be despatched.
- (iii) All records of routine test reports shall be maintained by the supplier at his works for periodic inspection by the purchaser.
- (iv) All test reports of tests, conducted during manufacture shall be maintained by the supplier. These shall be produced for verification as and when required for by the purchaser.

11.0 SPARE PARTS:

A list of spare parts recommended for five years operations for each Current Transformer shall be furnished with the tender. The purchaser will decide the actual quantities of spare parts to be ordered on the basis of the list and the item wise price of spare parts.

12.0 The necessary galvanized flanges, bolts etc. for the base of the Current Transformers shall be supplied without any extra cost to the purchaser.

13.0 PACKING AND FORWARDING:

The equipment shall be packed in suitable crates so as to withstand handling during transport and outdoor storage during transit. The supplier shall be responsible for any damage to the equipment during transit, due to improper and inadequate packing. The easily damageable material shall be carefully packed and marked with the appropriate caution symbols. Wherever necessary, proper arrangement for lifting such as lifting hooks etc. shall be provided. A material found short inside the packing cases shall be supplied by supplier without any extra cost.

Each consignment shall be accompanied by a detailed packing list containing the following information's :-

- (a) Name of the consignee
- (b) Details of consignment
- (c) Destination
- (d) Total weight of consignment
- (e) Sign showing upper / lower side of the crate
- (f) Handling and unpacking instructions
- (g) Bill of materials indicating contents of each package.

The supplier shall ensure that the bills of materials is approved by the purchaser before dispatch.

Any tender without complete information, as asked for in the above specification, is likely to be rejected.

APPENDIX-I
TECHNICAL REQUIREMENT FOR 33kV

The Current Transformers under this specification shall conform to the parameters given below :-

Sl. No.	Item.	Specification
		36kV
1	Type of CT/Installation.	Single phase, Live/dead tank, oil filled, hermetically sealed, outdoor, self-cooled
2	Type of mounting.	Pedestal type
3	Suitable for system frequency.	50 HZ \pm 5 %
4	Rated voltage (KVrms)	33
5	Nominal system voltage (KV rms)	33
6	Highest system voltage (KV rms)	36
7	Current ratio (A/A)	a)800-400- 200/1-1-1A b)800-400-200/ 1-1-1-1A c)800-400-200/1A
8.	Method of earthing the system where the current transformer will be Installed.	Solidly Effectively earthed.
9	Rated continuous thermal current (A)	120 % of rated primary current(Lower & Higher)

10	Acceptable limit of temperature rise above 50°C ambient temperature for continuous operation at rated continuous thermal current.	
(a)	Winding	45°C As per IEC 61869/60044-1 or IS-2705
(b)	Oil	40°C
(c)	External surface of the core, metallic parts in contact with or adjacent to, insulation.	45°C
11	Acceptable partial discharge level	Less than 10 pico coulombs
12.	Maximum radio interference voltage at 1.1 times the maximum rated voltage.	Less than <1000 μV
13.	1.2/50 micro second lightning impulse withstand voltage (KVP) (dry)	170
14.	1 minute dry power frequency withstand voltage primary (kV rms)	70
15.	Switching Impulse with stand and voltage (KVP)	--
16.	1 Minute dry power frequency withstand voltage secondary (KV rms)	3

17.	Minimum creepage distance of porcelain Housing (mm)	1116
18.	Rated short time withstand current for 1 second at all ratios (KA rms)	31.5kA
19.	Instrument security factor at all ratios for metering core.	Not more than 5.0
20.	Minimum rated short time thermal current density of the primary winding at all ratios (A/mm ²)	As per clause No9.6.3- Note of IS: 2705 (Part-I)/1992
21.	Application, current ratio, output burden, accuracy class, minimum knee point voltage, secondary winding resistance, maximum excitation current at minimum knee point voltage etc.	Enclosed in separate sheets for each rating of the Current Transformers.
22.	Type of core	Torroidal type
23.	Seismic acceleration	0.15g (Vertical) 0.3g (Horizontal)
24.	Accuracy class of standard C.T. to be used during testing towards determination of ratio Errors and phase angle errors for metering cores	0.05 or better

**SPECIFIED PARAMETERS FOR KP.V, SEC. WDG.
RESISTANCE, EXCITATION**

CURRENT FOR PX CLASS CORES

33kV CT

AND

BURDEN, ISF FOR METERING CORES

OF

ACC.CLASS 0.2S for 33kV CT

REQUIREMENT FOR 36KV CURRENT TRANSFORMERS:

36kV Transformer bay:

No. of Cores	Core No.	Application	Current Ratio	Output burden in VA	Acc: class as per IS:2705	Minimum knee point voltage (V_k) at all ratios in volts.	Maximum CT resistance R_{CT} in ohms at 75°C at all ratios	Maximum excitation current at V_k in mA at all ratios.	Instrument security factor at all ratios
1	2	3	4	5	6	7	8	9	10

36KVCT; RATIO-800-400-200/1-1-1A

4	1	Protection	800/1	-	PS	450	10	40	-
			400/1	-	PS				
			200/1	-	PS				
	2.	Protection	800/1	20	5P20	-	-	-	-
			400/1	20	5P20				
			200/1	20	5P20				

	3.	Protection	800/1	-	PS				
			400/1	-	PS	450	10	40	-
			200/1	-	PS				
	4.	Protection	800/1	-	PS				
			400/1	-	PS	450	10	40	-
			200/1	-	PS				

36kV Bus coupler & Feeder:

No. of Cores	Core No.	Application	Current Ratio	Output burden in VA	Acc:classes perIS:2705	Minimum knee point voltage (V _k) at all ratios in volts.	Maximum CT resistance RCT _{inoh} msat75°C at all ratios	Maximum excitation current at V _k in mA at all ratios.	Instrument security factor at all ratios
1	2	3	4	5	6	7	8	9	10

36KVCT; RATIO-800-400-200/1-1-1

3	1	Protection	800/1	20	5P20				
			400/1	20	5P20	-	-	-	-
			200/1	20	5P20				
	2.	Protection	800/1	-	PS				
			400/1	-	PS	450	10	40	-
			200/1	-	PS				
	3.	Protection	800/1	-	PS				
			400/1	-	PS	450	10	40	-
			200/1	-	PS				

36kV Feeder MCT:

No. of Cores	Core No.	Application	Current Ratio	Output burden in VA	Acc:classes perIS:2705	Minimum knee point voltage (V_k) at all ratios in volts.	Maximum CT resistance RCTinohmsat75°C at all ratios	Maximum excitation current at V_k in mA at all ratios.	Instrument security factor at all ratios
1	2	3	4	5	6	7	8	9	10

36KVCT; RATIO-800-400-200/1A

1	1	Metering	800/1	10	0.2S				5 or Less
			400/1	10	0.2S	-	-	-	5 or Less
			200/1	10	0.2S				5 or Less

ANEXURE – A

**GUARANTEED TECHNICAL PARTICULARS
FOR CURRENT TRANSFORMER.**

SL. NO.	DESCRIPTION	(33k V)
		RATIO-800-400-200/ 1-1-1A
1.	Bidder's name and address	
2.	Name and address of the Manufacturer	
3.	Manufacture's type designation	
4.	Standards applicable	
5.	Rated frequency (HZ)	
6.	Rated Voltage (KV)	
7.0	Rated current (A)	
7.1	Rated continuous current (A)	
7.2	Rated extended primary current(A)	
8.	Short time thermal current withstand for stipulated time duration (KA)	
9.	Dynamic current withstand (KAP)	
10.	1.2/50 μ s impulse withstand voltage (KVP)	
11.	One minute dry and wet power frequency withstand voltage (KV-rms)	
12.	No. of cores per CT	
13.	Transformation Ratio	
14.	No. of secondary turns	
15.	Rated output at all ratios for metering	

SL. NO.	DESCRIPTION	(33k V)
	core (VA)	
16.	Accuracy class	
17.	Minimum Knee point voltage at different taps for all 'PS' class cores (V)	
18.	Secondary winding resistance at different taps for all cores (\square) (750°C)	
19.0	Maximum exciting current at all ratios (for all PS class cores)	
19.1	100% KPV (Knee point voltage) (mA)	
19.2	25% KPV (Knee point voltage) (mA)	
19.3	20% KPV (Knee point voltage) (mA)	
19.4	10% KPV (Knee point voltage) (mA)	
20.	Instrument security factor at different ratios.	
21.	Radio interference voltage at 1.1 Vr / 31/2 at 1.0 MHZ (Micro volts)	
22.	Whether auxiliary CT provided for metering winding	
23.	Corona extinction voltage (KV rms)	
24.	Partial discharge level (PC)	
25.	Total creepage distance (mm)	
26.	Primary	
26.1	No. of primary turns	
26.2	Material and cross- section of primary	

SL. NO.	DESCRIPTION	(33k V)
	(mm ²)	
26.3	Type of primary	
27.	Whether CT is suitable for transportation horizontally.	
28.	Percentage current (ratio) error and phase displacement in minutes at rated burden and at	
28.1	5% rated current	
28.2	10% rated current	
28.3.	20% rated current	
28.4.	120% rated current	
29.	Percentage current (ratio) error and phase displacement in minutes at 25% rated burden and	
29.1	At 5% rated current	
29.2	At 10% rated current	
29.3.	At 20% rated current	
29.4.	At 120% rated current	
30.	Quantity of oil per CT (Litres)	
31.	Standard to which oil conforms generally.	
32.	Characteristics of oil (prior to filling)	
32.1	Breakdown voltage (kV rms)	
32.2	Dielectric dissipation constant (tan delta)	
32.3	Water content (ppm)	
32.4	Gas content	
32.5	Interfacial tension at 270C (N/m)	
32.6	Specific resistance	

SL. NO.	DESCRIPTION	(33k V)
32.6.1	At 900C (□cm)	
32.6.2	At 270 C (□cm)	
33.	Whether current transformers are hermetically sealed. If so, how	
34.	Total weight (Kg)	
35.	Transport weight (Kg)	
36.1	Temperature rise over an ambient temperature of 500C for continuous operation at rated continuous thermal current.	
36.1	Winding	
36.2	Oil	
36.3	External surface of the core, metallic parts in contact with or adjacent to insulation.	
37.	Whether CT characteristic curves enclosed.	
37.1	Ratio and phase angle curve	
37.2	Magnetization curves	
37.3	Ratio correction factor curves.	
38.	DATA ON PRIMARY WINDING	
38.1	Rated primary current (A)	
38.2	No. of conductors in one turn	
38.3	No. of turns of primary	
38.4	Material of the primary conductors	
38.5	Size of the primary conductor (Bare/ Insulated (mm x mm)	
38.6	Cross-sectional area of each conductor (mm ²)	

SL. NO.	DESCRIPTION	(33k V)
38.7	Total cross- sectional area of primary winding (mm ²) conductors	
38.8	Current density(A/mm ²)	
	(i) At highest ratio	
	(ii) At intermediate ratio	
	(iii) At lowest ratio	
38.9	Short circuit current density (A/mm ²)	
	(i) At highest ratio	
	(ii) At intermediate ratio	
	(iii) At lowest ratio	
38.10	Ampere-turn of Primary (AT)	
	(i) At highest ratio	
	(ii)At intermediate ratio	
	(iii) At lowest ratio	
38.11	Length of primary conductor (m)	
38.12	Weight of primary winding (kg.)	
39.	CORE	
39.1	Material and grade of the core	
39.2	Thickness of core (mm)	
39.3	Net Iron cross- sectional area of core (mm ²)	
39.3.1	Core-1	
39.3.2	Core – 2	
39.3.3	Core – 3	
39.3.4	Core – 4	
39.3.5	Core – 5	
39.4	Mean magnetic path length (cm)	
39.4.1	Core – 1	
39.4.2	Core – 2	

SL. NO.	DESCRIPTION	(33k V)
39.4.3	Core – 3	
39.4.4	Core – 4	
39.4.5	Core – 5	
39.5	Whether B-H curve for the core material, used, furnished? (B wb/m ² , H-AT/cm)	
39.6	Whether specific loss vs. flux density graph for the core material used furnished?	
39.7	Axial length of core (mm)	
39.7.1	Core – 1	
39.7.2	Core – 2	
39.7.3	Core – 3	
39.7.4	Core – 4	
39.7.5	Core – 5	
39.8	Inside diameter / outside diameter of the cores (mm)	
39.8.1	Core – 1	
39.8.2	Core – 2	
39.8.3	Core – 3	
39.8.4	Core – 4	
39.8.5	Core – 5	
39.9	Weight of the core (kg)	
39.9.1	Core – 1	
39.9.2	Core – 2	
39.9.3	Core – 3	
39.9.4	Core – 4	
39.9.5	Core – 5	
40.	SECONDARY WINDINGS	

SL. NO.	DESCRIPTION	(33k V)
40.1	Rated secondary current (A)	
40.2	Material of the secondary windings	
40.3.	Size of the secondary conductor [Bare / Insulated] [mm]	
40.3.1	Core – 1	
40.3.2	Core – 2	
40.3.3	Core – 3	
40.3.4	Core – 4	
40.3.5	Core – 5	
40.4	Cross sectional area of the secondary conductor (mm ²)	
40.4.1	Core – 1	
40.4.2	Core – 2	
40.4.3	Core – 3	
40.4.4	Core – 4	
40.4.5	Core – 5	
40.5	Current density of secondary windings (A/mm ²)	
40.5.1	Core – 1	
40.5.2	Core – 2	
40.5.3	Core – 3	
40.5.4	Core – 4	
40.5.5	Core – 5	
40.6	No. of secondary turns	
40.6.1	Core – 1	
40.6.2	Core – 2	
40.6.3	Core – 3	
40.6.4	Core – 4	
40.6.5	Core – 5	

SL. NO.	DESCRIPTION	(33k V)
40.7	No. of layers	
40.7.1	Core – 1	
40.7.2	Core – 2	
40.7.3	Core – 3	
40.7.4	Core – 4	
40.7.5	Core – 5	
40.8	No. of turns / layer	
40.8.1	Core – 1	
40.8.2	Core – 2	
40.8.3	Core – 3	
40.8.4	Core – 4	
40.8.5	Core – 5	
40.9	Average length / turn of secondary windings (mm)	
40.9.1	Core – 1	
40.9.2	Core – 2	
40.9.3	Core – 3	
40.9.4	Core – 4	
40.9.5	Core – 5	
40.10	Resistance of the conductor used for secondary winding per meter length at 750C (Ω /M)	
40.11	Weight of secondary windings (kg)	
40.11.1	Core – 1	
40.11.2	Core – 2	
40.11.3	Core – 3	
40.11.4	Core – 4	
40.11.5	Core – 5	
41	INSULATION	

SL. NO.	DESCRIPTION	(33k V)
41.1	Name and class of insulating material between core and secondary winding.	
41.2	Name/s of Insulating materials between secondary winding and primary windings.	
41.3	Insulating materials used to achieve grading of capacitance.	
42.	DIAMETER OF WINDINGS	
42.1	Inside / outside diameter of secondary windings (mm)	
42.1.1	Inside / outside diameter of secondary windings (mm)	
42.1.1	Core – 1	
42.1.2	Core – 2	
42.1.3	Core – 3	
42.1.4	Core – 4	
42.1.5	Core – 5	
42.2	Inside / outside diameters of primary winding (mm)	
42.3	Minimum clearance from tank (mm)	
42.4	Minimum clearance from secondary to tank (mm)	
43.	TANK AND SECONDARY TERMINAL BOX	
43.1	Material of the CT tank	
43.2	Material of the CT secondary terminal box	
43.3	Thickness of CT tank material (mm)	
43.4	Thickness of CT secondary terminal box material (mm)	

SL. NO.	DESCRIPTION	(33k V)
43.5	Zinc coating of the CT tank (gm/m ²) as per relevant upto date ISS	
43.6	Zinc coating of the CT secondary terminal box (gm/m ²) as per the relevant upto date ISS.	
43.7	Ingress protection rating of the secondary terminal box.	
43.8	Weight of the tank, fittings and other accessories (kg)	
44.	TERMINAL CONNECTOR	
44.1	Manufacturer's name	
44.2	Applicable standard	
44.3	Type	
44.4	Material of connector	
44.4.1	Clamp body	
44.4.2	Bolts and Nuts	
44.4.3	Spring washers	
44.5	Rated current (Amp)	
44.6	Rated terminal load (Kg)	
44.7	Factor of safety	
44.8	Minimum thickness of any part (mm)	
44.9	Weight of clamp complete with hardwares (kg)	
44.10	Type test reports as per IS enclosed	
44.11	OGA drawing enclosed	
45.	INSULATOR	
45.1	Manufacturer's name	
45.2	Type	
45.3	Applicable standards	

SL. NO.	DESCRIPTION	(33k V)
45.4	Height (mm)	
45.5	Diameter (top) (mm)	
45.7	Total creepage distance (mm)	
45.8.	Rated voltage (KV)	
45.9	Power frequency withstand voltage for 1 min. dry and wet. (KV – rms)	
45.10	1.2/50 micro-sec impulse withstand voltage (KVP)	
45.11	Corona extinction voltage (KV)	
45.12	Weight (Kg)	
45.13	Maximum allowable span (mm)	
45.14	Cantilever strength (Kg)	
45.15	The drawing enclosed.	
46.	Accuracy class of standard C.T. to be used towards determination of ratio errors and phase angle errors for metering cores.	

ANNEXTURE – B. CALLIBRATION STATUS OF TESTING EQUIPMENTS AND INSTRUMENTS / METERS

Name of the Test	Meters & Equipment required for the corresponding test with range accuracy, make & Sl.No.	Date of Calibration	Due Date of Calibration	Name of the Calibration Agency	Whether Calibration Agency is Govt. approved	Whether documents relating to Govt. approval of the calibrating Agency furnished	Whether the meters / equipments fulfill the accuracy class as per calibration report	Whether the calibrating agency has put any limitation towards the use of the particular meter / equipment. If yes state the limitations.	Whether green sticker or Blue Sticker or Yellow Sticker has been affixed on the body of the particular equipment / meter. State the colour of the affixed sticker	In spite of imposed limitations, whether the particular meter / equipment can still be used? Justify its use for corresponding test (s)	Remarks
1	2	3	4	5	6	7	8	9	10	11	12

Signature of the Tenderer with seal and date

OUTDOOR TYPE C.T. & P.T. CONSOLES/ MARSHALING BOX:

C.T., & P.T. consoles. Marshalling box shall be of aluminium alloy sheet of 3mm thick are to be supplied along with the C.T., & P.T. equipment. One console box is required for 3 nos. equipment. Details of quantities required are to be engineered by the contractor. These consoles are suitable for outdoor mounting and shall have proper slope at the top for easy discharge of water.

- (I) Marshalling Boxes shall be weather proof with a rating not less than IP- 55
- (II) The C.T., & P.T. console shall be of Aluminium alloy sheets having 3 mm thickness.
- (III) The Marshalling box shall be provided with a removable cable gland plate at bottom for mounting cable glands for 1.1KV PVC sheathed 4 x 4 Sq. mm stranded copper conductor cables.
- (IV) The Marshalling box shall be provided with a double leaf door in front so as to have easy access of terminals. The door shall have a sealing / locking arrangement and shall be suitable to prevent penetration of moisture and rainwater.
- (V) All terminals shall be clearly marked with identification number to facilitate connection to external wiring.
- (VI) Terminal Block connectors (Reputed make like Elmex, Wago) built from cells of molded dielectric and brass stud inserts shall be provided for terminating the outgoing ends of the wiring and the corresponding incoming tail ends of the control cables. All the terminal connectors shall have de-link (disconnecting) facilities. Provision shall be made on each pillar for holding 20% extra connection (10% incoming + 10% outgoing). All blocks shall be shrouded by easily removable shroud molded of transparent dielectric materials. The terminal blocks shall be suitable for 660 volts service and connection with both aluminum and copper cable.
- (VII) Provision of Illumination lamp, Thermostat control auto heater & 3 pin socket with plug in each Marshalling Box. The Supply shall be 230 V A.C. Necessary wiring in the MB shall also be provided.
- (VIII) The sizes of the MB for C.T., & P.T. shall be finalized during detailed Engineering.

Part-13
33kV POTENTIAL TRANSFORMER

TECHNICAL SPECIFICATION FOR 33kV POTENTIAL TRANSFORMER

1. SCOPE:

This specification provides for the design, manufacture, assembly inspection and testing at the manufacturer's works, packing and delivery FOR [Destinations] of outdoor mounted type, single phase, oil filled, self-cooled, single unit type voltage transformers for 33kV system, 33kV system to be used for voltage indication, supply of potential to tariff meters, relays for feeder protection in Grid Sub-stations of OPTCL.

The VTs shall be complete in all respects with insulators, bimetallic connectors, fixing details etc. as described herein.

Bidders are required to quote for 0.2 accuracy class [metering winding] for 33kV VTs in the following manner.

- a) Guaranteed Technical Particulars.
- b) Technical literatures, brochures and drawings as per this specification.
- c) Type Test reports.
- d) List of orders, executed and Users' certificates with offer, failing submission of the above particulars with the offer, the tender may not be considered for evaluation.

2. Following is the list of documents constituting this Specification.

- | | | |
|-------|--|-----------------|
| (i) | Technical Specification (TS). | |
| (ii) | Technical requirements. | - [Appendix-I] |
| (iii) | Quantity and delivery schedule. | - [Appendix-II] |
| (iv) | Guaranteed Technical Particulars.- | [Annexure-A] |
| (v) | Calibration status of testing equipment and meters/Instruments.- | [Annexure-B] |
| (vi) | Check list towards Type Test Reports.- | [Annexure-C] |

N.B.:- Annexure - A, B, C are to be filled up by the Bidder.

3. STANDARDS:

The VTs shall conform in all respects to high standards of Engineering, design, workmanship and latest revisions of relevant standards at the time of offer and the Purchaser shall have the power to reject any work or material which in his judgement is not in full accordance therewith. Except to the extent modified in the specifications, the VTs shall conform to the latest editions and the amendments of the standards listed hereunder:

Bidders may please note that 33kV voltage transformer shall be manufactured, tested and supplied with all guaranteed technical particulars generally conforming to meet the requirement of this technical specification and relevant latest national standards of India or international electro technical commission standards with latest amendments of relevant standards rules and codes.

S No	Standard Ref. No.	Title.
1.	IEC-44(4)	Instrument Transformer – measurement of PDS
2.	IEC-60	High voltage testing techniques.
3.	IEC-171	Insulation co-ordination.
4.	IEC-186	Voltage Transformers.
5.	IEC-186(A)	Voltage Transformers (first supp. to IEC- 186)
6.	IEC-270	Partial discharge measurement.
7.	IS-335	Insulating oil for transformers and switch gears.
8.	IEC-8263	Method for RIV Test on high voltage insulators.
9.	IS-2071	Method of high voltage testing.
10.	IS-2099	High Voltage porcelain bushings.
11.	IS-2147	Degree of protection provided by enclosures for low voltage switch-gear and control.
12.	IS-2165	Insulation co-ordination for equipments of 100KV and above.
13.	IS-3156 (Part-I to IV).	Voltage transformers.
14.	IS-3347	Dimensions of porcelain transformer bushings.
15.	IS-4146	Application guide for voltage transformers.
16.	IS-5547	Application guide for Capacitor Voltage Transformers.
17.	IS-9348	Coupling Capacitor & Capacitor Devices.
18.	IEC 61869-5/1	CVT

All the above along with the amendments thereof shall be read and interpreted together. However, in case of a contradiction between the Technical Specification and any other volume, the provisions of this Technical Specification will prevail.

The voltage transformers with the requirements of other authoritative standards, which ensure equal or better quality than the standards, mentioned above shall also be acceptable. Where the equipment, offered by the supplier conforms to other standards, salient points of difference between the standards shall be brought out in the offer.

4. CLIMATIC AND SERVICE CONDITIONS :

The VTS are required to operate satisfactorily under the following conditions.

- | | | |
|--|---|-----------|
| a) Maximum ambient temperature | – | 50°C. |
| b) Maximum daily average ambient air temperature | – | 32°C. |
| c) Maximum relative humidity | – | 100%. |
| d) Average number of rainy days in a year | – | 120 days. |
| e) Average annual rainfall | – | 150 cms. |
| f) Altitude not exceeding | – | 1000 M. |
| g) Basic wind speed | – | 50m/s. |

5. EARTHQUAKE INCIDENCE:-

The VTS are to be designed to withstand earthquake of an intensity, equivalent to 0.3g in the horizontal and 0.15g in the vertical direction

Where, 'g' stands for acceleration due to gravity.

PURCHASER'S AUXILIARY POWER SUPPLY:-

Following power supplies shall be made available at site:

- (a) AC-3 phase, 415V, 50HZ earthed.
- (b) AC single phase, 240V, 50HZ earthed.
- (c) 220V DC, Ungrounded.

All equipment and devices shall be capable of continuous satisfactory operation on AC and DC supplies of nominal voltage, mentioned above with variations as given below.

- | | |
|---|------------------|
| (d) AC voltage variation. | ± 10% |
| (e) Frequency variation. | ± 5%. |
| (f) Combined voltage & frequency variation. | ± 10% |
| (g) DC voltage variation. | 190V to 240V DC. |

The supplier shall make his own arrangements for the power supplies other than those specified under Clause-5.1 above.

6. INSTALLATION:-

The VTS covered under this specification shall be suitable for outdoor installation without any protection from rain, dust, mist and direct rays of the sun.

7. GENERAL TECHNICAL REQUIREMENTS FOR VT :-

Each VT shall be supplied, filled with insulating oil and shall be hermetically sealed to prevent atmosphere coming in contact with oil, avoiding filtration and change of oil. Stain less Steel Bellow shall be provided to take care of the expansion in the oil due to various stresses developed in the VTs.

However, the VT shall have a provision for draining and filling insulating oil after drying or preferably must have arrangement for drying the oil by continuous process with oil filters.

The VT shall be suitable for transport in horizontal position if the transport limitations so demand.

SECONDARY TERMINAL BOX:-

The secondary terminals shall be brought out in a weather proof terminal box made up of Aluminium cast with a rating not less than IP-55.

All secondary terminals shall be brought out in a compartment on one side of each VT for easy access.

Provision of Thermostat control Heater in the secondary box. The Voltage shall be 230 V AC. The terminal box shall be provided with removable gland plate and glands suitable for 1100 volts grade. PVC insulated, PVC sheathed multi core 4 sq.mm to 6 sq.mm stranded copper conductor cable.

The terminal box shall be provided with a door in front so as to have easy access of secondary terminals. The door shall have a sealing/locking arrangement and shall be suitable to prevent penetration of moisture and rain water.

The dimensions of the terminal box and its openings shall be adequate to enable easy access and sufficient working space for use of normal tools.

The terminal blocks shall be standard type and provided with ferrules indelibly marked or numbered and their identifications shall correspond to the designation on the relevant wiring diagram.

Secondary wiring terminal studs shall be provided with at least three nuts, plain and spring washers. The studs, nuts and washers shall be of brass, duly nickel plated. The minimum diameter of the studs shall be 6 mm. The length of at least 15 mm shall be available on the studs for inserting the leads.

Primary earthing link should be provided for measurement of capacitance & dielectric dissipation factor.

Separate point should be provided

Polarity shall be indelibly marked on each primary and secondary terminal.

The VT shall be vacuum filled with oil after processing and thereafter hermetically sealed to eliminate breathing and to prevent air and moisture from entering the tanks. Oil filling and/or oil sampling cocks, if provided to facilitate factory processing should be properly sealed before dispatching the VT. The method, adopted for hermetic sealing shall be described in the offer.

The castings of base, collar etc. shall be die cast and tested before assembly to detect cracks and voids, if any.

The characteristics of the VTS shall be such as to provide satisfactory performance such as voltage error and phase displacement at rated frequency shall not exceed the values as per relevant standards at any voltage between 80% and 120% of rated voltage and with burdens of between 25% and 100% of rated burden at a power factor of 0.8 lagging. The error shall be determined at the terminals of the IVT and shall include the effects of any fuses or resistors as an integral part of the IVT.

Inductive voltage transformers shall be designed so as to achieve the minimum risk of explosion in service. The bidder shall bring out in his offer, measures taken to achieve this.

PRIMARY WINDING:-

Primary winding of the VT will be connected phase to neutral with the neutral point solidly earthed. The arrangement for this shall be included in the scope of supply. The primary conductor shall be of adequate cross-section so that the maximum permissible current density shall not be exceeded even during short-circuit conditions.

SECONDARY WINDING:

Suitably insulated copper wire of electrolytic grade shall be used for secondary windings. The secondary conductor shall be of adequate cross section so that the maximum permissible current density shall not be exceeded even during short-circuit conditions. Secondary windings details, burden & accuracy class are mentioned in Appendix-I. Secondary windings shall be used for metering, relaying and synchronizing. Each winding shall comply requirements of both Part-II and III of up-to-date editions of IS-3156/IEC-186.

CORE:-

Core laminations shall be of cold rolled grain oriented silicon steel or other equivalent alloys of low hysteresis and eddy current losses, high permeability to ensure accuracy i.e. 0.2 accuracy class at both normal and high over voltage. The core material, thickness of lamination, the relevant graphs showing the characteristics of the core materials shall be submitted along with the offer.

TANK:

Both expansion chambers and tanks of the VT shall be made of high quality Aluminium cast and shall be able to withstand full vacuum and pressure, occurring during transit and thermal and mechanical stresses resulting from maximum short circuit current during operation. The tank shall have bare minimum number of welded joints so as to minimize possible locations of oil leakage. Welding in horizontal plane is to be avoided as welding at this location may give way due to vibrations during transport resulting in oil leakage. Supplier has to obtain specific approval from the purchaser for any horizontal welding, used in the bottom tank

PORCELAIN HOUSING:

The housing shall be made up of homogeneous, vitreous porcelain of high mechanical and dielectric strength, Glazing of porcelain shall be of uniform brown or dark brown colour with a smooth surface, arranged to shed away rain water or condensed water particles (fog). The details of location and type of joint, if provided on the porcelain, shall be furnished by the Bidder along with the offer.

The bushings of the VTS shall conform to latest edition of IS-2099. The hollow porcelain insulators shall conform to the latest edition of IS-5621

The insulators shall be cemented with Portland cement to the flanges resulting in high mechanical, tensile and breaking strength

The bushings shall have ample insulation, mechanical strength and rigidity for the condition under which they shall be used and shall be designed to prevent accumulation of explosive gases and provide adequate oil circulation to remove the internal heat.

Cast metal and caps for the bushings shall be of high strength Aluminium Cast. They shall have smooth surface to prevent discharge taking place between the metal parts and porcelain as a result of ionisation.

The insulation of bushings shall be co-ordinated with that of the VT such that the flashover, if any, shall occur only external to the VT.

Oil level gauge and convenient means of filling, sampling and draining of oil shall be provided.

End shields should be provided for distribution of stresses.

Corona shields for bushings, if required, should be provided.

INSULATING OIL:

The quantity of insulating oil for the filling and the complete specification of the insulating oil shall comply in all respects with the provisions of the latest edition of IS-335.

The VTS shall be supplied completely filled with purified oil.

PREVENTION OF OIL LEAKAGE AND ENTRY OF MOISTURE:

The supplier shall ensure that the sealing of the VT is properly achieved. In this connection, the arrangement provided by the supplier at various locations including the following ones shall be described, supported by sectional drawings

- (a) Locations of emergence of primary & secondary terminals.
- (b) Interface between porcelain housing and metal tank(s).
- (c) Cover of the secondary terminal box.

Nuts and bolts or screws used for fixation of the interfacing porcelain bushings for taking out terminals shall be provided on flanges, cemented to the bushings and not on the porcelain. For gasketed joints, wherever used, nitrile butyl rubber gaskets shall be used. The gasket shall be fitted in properly machined groove with adequate space for accommodating the gasket under compression.

FITTINGS AND ACCESSORIES:-

Fittings and accessories, listed below shall be supplied with each VT. Any fitting, required essential other than those listed below shall also be supplied along with each VT.

- a) Oil level gauge.
- b) Oil filling hole and cap.
- c) Pressure relieving device.
- d) Lifting lugs for core and windings, bushings & complete transformers.
- e) Phase terminal connectors.
- f) Tank earthing pads/terminals with necessary nuts and bolts and washers for connecting to Purchaser's strip.
- g) Name/Rating plate.
- h) MCB's

OIL LEVEL GAUGE:-

An oil level gauge shall be provided to indicate the oil level in the VT. This gauge shall be mounted in such a way that the oil level can be seen from the ground level.

PRESSURE RELIEVING DEVICE:-

Each VT shall be provided with a pressure relieving device so as to protect bushing of the IVT even under unfavourable conditions.

OIL DRAIN COCK:-

An oil drain cock along with a stop cock shall be provided in the bottom flange so as to permit taking of oil samples for testing, if required.

EARTHING:-

Metal tank of each VT shall be provided with two separate earthing terminals for bolted connection to 50mm x 6mm flat to be provided by the Purchaser for connection to station earth-mat.

LIFTING ARRANGEMENT:-

The VT shall be provided with suitable lifting arrangement to lift the entire unit. The lifting arrangement shall be clearly shown in the general arrangement drawing. Lifting arrangement [Lifting eye] shall be positioned in such a way so as to avoid any damage to the porcelain housing or the tanks during lifting for installation/transport. Necessary string guides shall be offered which shall be of removable type.

NAME PLATE:-

The VT shall be provided with non-corrosive legible name plate with the information specified in relevant standards, duly engraved/punched on it.

GASKET JOINT:-

The manufacturer shall furnish the type of gasket used or setting methods.

TERMINAL CONNECTORS:-

All the VTS shall be provided with bimetallic solder less clamp type, rigid type terminal connectors, suitable for ACSR Twin Moose/Moose Conductor for 33kV VT. Each terminal connector shall be of universal type, suitable for both horizontal and vertical connections to the transmission line conductors/station bus bar.

TERMINAL CONNECTORS shall be manufactured and tested as per IS: 5561.

All castings shall be free from blow holes, surface blisters, cracks and cavities.

All sharp edges and corners shall be blurred and rounded off.

No part of a clamp shall be less than 10mm thick.

All ferrous parts shall be hot dip galvanized conforming to IS-2633. For bimetallic connectors, copper alloy linear of minimum thickness of 2 mm shall be cast integral with aluminium body.

All current carrying parts shall be designed and manufactured to have minimum contact resistance.

Connectors shall be designed to be corona free in accordance with the requirements, stipulated in IS-5561.

SECONDARY WIRING:-

The Secondary wiring shall be enclosed in conduits and shall be brought to a terminal block ready for external connections. The wiring shall be of adequate cross-section and not less than 4.00 sq.mm copper wire.

The supplier shall supply necessary hardwares, required for connection of phase side conductor to the line terminal and the grounding strip to the grounding terminal.

Necessary nuts and bolts for fixing the VTS on the supporting structures shall be in tenderer's scope of supply.

8. TESTS:-**Type Tests:-**

The offered 33kV voltage transformer should have been subjected to the following type tests in a Government approved Test Laboratory. The bidder shall furnish four sets of

type test reports along with the offer. For any change in the design/type already type tested and to the design/type offered against this specification, the purchaser reserves the right to demand repetition of some or all type tests/special tests without any extra cost to OPTCL in the presence of purchaser's representative at the cost of the supplier.

Tests Include:

- Temperature rise test
- Lightning Impulse test
- High voltage power frequency wet withstand voltage tests
- Determination of errors
- IP-55 Test on Secondary Terminal Box

N.B: i) The dielectric type tests have been carried out on the same VT

ii) After the VT was subjected to the dielectric tests, it should have been subjected to all routine tests as per relevant standards

iii) For Temperature rise test, the test must have been made with the appropriate rated burden, connected to each secondary winding.

Routine Tests:

The following routine tests shall be conducted on each VT in the presence of Purchaser's representative for which no charges will be payable by OPTCL. No sampling is allowed.

- Verification of terminal markings
- Power frequency withstand tests on primary windings
- Power frequency withstand tests between sections
- Determination of errors on complete VT.
- Measurement of Insulation resistance
- Oil leakage tests
- Measurement of Capacitance and dielectric dissipation factor before and after dielectric tests(s per IEC-358)
- Any other tests as per relevant national and International standards.

N.B: Determination of errors shall be performed after the other tests. The standard reference VT to be used during testing for determination of ratio error and phase angle error should of 0.05 Accuracy class or better as per standard practice, presently adopted by OPTCL.

9. INSPECTION:

The Purchaser shall have access at all times to the works and all other places of

manufacture, where the VTs are being manufactured and the supplier shall provide all facilities for unrestricted inspection of the supplier's works, raw materials, manufacturer of all the accessories and for conducting the necessary tests.

The Supplier shall keep the Purchaser informed in advance of the time of starting and of the progress of manufacture of equipment in its various stages so that arrangement could be made for inspection at the discretion of the Purchaser.

No material shall be despatched from its manufacture unless the material has been satisfactorily inspected, tested and despatch clearance issued. However, the Purchaser reserves the right to alter the despatch schedule attached to this Specification.

The acceptance of any quantity of equipment shall in no way relieve the supplier of his responsibility for meeting all the requirements of this Specification and shall not prevent subsequent rejection, if such equipment are found to be defective.

Clear 15 (Fifteen) days' notice shall be given to this office for deputing officer(s) for inspection. The Voltage Transformers shall be despatched only after the inspection is conducted by a representative of OPTCL and release order, issued from this office after approval of Routine Test Certificates. The shop routine test certificates in triplicate for all the Voltage Transformers along with the calibration certificates of all the meters and equipment to be used during testing (as per Annexure-B of the Specification) should be furnished along with the Inspection Offer. The Inspecting Officer will be authorised for inspection of the Voltage Transformers subject to the condition that the routine test certificates and calibration certificates of the testing equipment/meters will be found to be in order.

10. QUALITY ASSURANCE PLAN:-

The Bidder shall invariably furnish following informations along with his offer.

- [i] Statement giving list of important raw materials, names of sub-suppliers for the raw materials, list of standards, according to which the raw materials are tested, list of tests, normally carried out on raw materials in presence of Bidder's representative, copies of test certificates.
- [ii] Information and copies of test certificates as in [i] above in respect of bought outitems.
- [iii] List of manufacturing facilities available.
- [iv] Level of automation achieved and list of areas where manual processing exists.
- [v] List of areas in manufacturing process where stage inspections are normally carried out for quality control and details of such tests and inspection.
- [vi] Special features provided in the equipment to make it maintenance free.

[vii] List of testing equipment, meters and test plant limitation, if any, vis-à-vis the type, acceptance and routine tests, specified in the relevant standards. These limitations shall be very clearly brought out in the offer.

[viii] All the testing equipment, meters etc. should have been calibrated in a Government approved laboratory. The Bidder must submit the list of testing equipment and meters test-wise as per ANNEXURE-B of the Technical Specification.

The Supplier shall within 30 days of placement of order submit the following information to the Purchaser.

[ix] List of raw materials as well as bought out accessories and the names of the materials as well as bought out accessories and the name of Sub-suppliers selected from those, furnished along with the offer.

[x] Type test certificates of the raw materials and bought out accessories.

[xi] Quality Assurance Plan (QAP) withhold points for the Purchaser's possible inspection. The QAP and hold points shall be discussed between the Purchaser and the Supplier before the QAP is finalised.

The Supplier shall submit the routine test certificates of bought out items and raw materials at the time of acceptance testing of the fully assembled equipment.

11. DOCUMENT:

The supplier shall furnish four sets of following drawings /documents along with his offer.

- [a] General outline and assembly drawings of the Voltage Transformers.
- [b] Sectional views showing:-
 - [i] General constructional features.
 - (ii) Materials/gaskets/sealing used.
 - iii] The insulation of the winding arrangements, method of connection of primary/secondary winding to the primary/secondary terminals etc.
- [c] Schematic drawing.
- [d] Rating & diagram plate as per relevant IEC/ISS
- [e] Secondary Terminal Box.
- [f] Assembly Sectional view of Primary terminal./ capacitor voltage divider
- [g] Assembly drawing for secondary terminal

- [h] The detailed dimensional drawing of Porcelain Housing such as ID,OD, thickness and insulator details such as height, profile of petticoats, angle of inclination and gap between successive petticoats, total creepage distance etc.
- [i] Sectional view of pressure release device.
- [j] Drawing showing details of Oil level.
- [k] All type test reports relating to the tests as specified in Clause-8.1 of the above.
- [l] Ratio and phase angle error curves for VTS
- [m] Magnetization characteristic curves such as B-H curves and Sp. Loss vs. Flux density curves for core material, used for VT.

12. TEST REPORTS:-

- [i] Four copies of type test/special test reports shall be furnished to the Purchaser with the tender offer.
- [ii] Copies of acceptance test reports and routine test reports shall be furnished to the Purchaser. One copy will be returned, duly certified by the Purchaser and only thereafter shall the materials be despatched.
- [iii] All records of routine test reports shall be maintained by the supplier at his works for periodic inspection by the Purchaser.
- [iv] All test reports of tests, conducted during manufacture shall be maintained by the supplier. These shall be produced for verification as and when required for by the purchaser.

13. The necessary galvanized flanges, bolts etc. for the base of the Voltage Transformers shall be supplied without any extra cost to the purchaser.

14. PACKING AND FORWARDING:-

The equipment shall be packed in suitable crates so as to withstand handling during transport and outdoor storage during transit. The supplier shall be responsible for any damage to the equipment during transit, due to improper and inadequate packing. The easily damageable material shall be carefully packed and marked with the appropriate caution symbols. Wherever necessary, proper arrangement for lifting such as lifting hooks etc. shall be provided. Any material found short inside the packing cases shall be supplied by supplier without any extra cost.

Each consignment shall be accompanied by a detailed packing list containing the following informations:

- [a] Name of the consignee.
- [b] Details of consignment.
- [c] Destination.
- [d] Total weight of consignment.

- [e] Sign showing upper, lower side of the crate.
- [f] Handling and unpacking instructions.
- [g] Bill of materials indicating contents of each package.
- [h] Set of approved drawings.

The supplier shall ensure that the bill of materials is approved by the Purchaser before despatch.

15. Any bid without complete information as asked for in the above Specification is likely to be rejected.

APPENDIX – I.

TECHNICAL REQUIREMENTS FOR 33kV VOLTAGE TRANSFORMERS

SL.NO	PARTICULARS	33 kV VT
1	Type	Single phase, 50Hz, oil filled, self cooled, Hermetically sealed, outdoor Porcelain type.
2	Nominal system voltage.	33 KV
3	Highest system voltage.	36 KV
4	Frequency.	50Hz ± 5%
5	System earthing.	Effectively solidly earthed
6	Number of phases.	3 [single phase]
7	(i) Number of secondary windings. (ii) Purpose of windings.	2 [two] Protection & metering.
8	Rated primary voltage.	33/1.732 KV
9	Rated secondary voltage.	Winding-I- 110/1.732 V (Protection) Winding- II-110/1.732V (Metering)

10	Ratio	33 kV/1.732 : 110V/1.732
11	Rated burden.	Winding- I(P)-75 VA Winding- II(M)- 75 VA Simultaneous Burden- 150 VA with accu. cl-0.2
12	Accuracy class	3P/ 0.2
13	Rated voltage factor at rated frequency.	1.2 continuous. 1.5 for 30 seconds.
14	Temperature rise at 1.2 times the rated primary voltage, rated frequency & rated burdens.	As per IEC-186.
15	Temperature rise at 1.5 times the rated primary voltage for 30 seconds, rated frequency & rated burden.	As per IEC-186.
16	One-minute power frequency dry withstands test voltage for primary winding.	70 KV [rms]

17	1-minute power frequency wet withstands test voltage for primary winding.	70 KV [rms]
18	1.2/50 micro second impulse withstand test voltage for primary winding	170 KV [peak]
19 (i)	One-minute power frequency withstands test voltage for Secondary winding Between LV(HF) terminal & earth terminal	3KV [rms]
(ii)		-
20	Class of insulation.	'A'
21	Material of the conductor of primary and secondary windings.	Copper.
22	Short Circuit Fault level of the bus to which the equipment will be connected.	31.5kA (rms) for 1 second.
23	Minimum creepage distance.	1116mm
24	Quality of oil.	EHV Grade As per IS-335.
25	Radio interference voltage at 1.1 times maximum rated voltage at 1.0 MHZ.	
26	Partial discharge level.	
27	Seismic acceleration-Horizontal – Vertical.	0.3g. 0.15g.
28	Accuracy class of standard V.T. to be used during testing towards determination of ratio errors and phase angle errors for metering windings.	0.05 or better.
29.	Capacitance (Pf)	-

ANNEXURE – A

GUARANTEED TECHNICAL PARTICULARS.

Sl.No	Description.	33 KV VT
.		
		3P/0.2 Accuracy Class
1	Bidder's name and address.	
2	Name and address of the Manufacturer.	
3	Manufacturer's type and designation.	
4	Standards applicable.	
5	Type of VT	
6	Rated primary voltage (kv).	
7	Rated secondary voltage (volts).	
7.1	Winding-I.	
7.2	Winding-II.	
7.3	Winding-III.	
8	Rated frequency [HZ].	
9	Rated burden:- Protection Winding Protection Winding Metering Winding	
10	Number of secondary windings.	
11	Accuracy class.	
[I]	[protection] Winding	
[II]	[metering] Winding	
12	Rated voltage factor for continuous operation at rated frequency.	
13	Rated voltage factor for 30 seconds at rated frequency.	
14	One minute dry and	

	wet power frequency withstand voltage for primary side [kv] rms.	
15	One minute power frequency withstand voltage for secondary winding [kv] rms.	
16	1.2/50 micro- second impulse withstand test voltage for primary side	
17	Temperature rise over an ambient temperature of 50°C	
[a]	With 1.2 times rated primary voltage at rated frequency and at rated burdens. [I] Winding [°C] [II] Oil [°C] [III] Other parts [°C]	
[b]	With 1.5 times rated primary voltage for 30 seconds at rated frequency and at rated burdens. [I] Winding [°C] [II] Oil [°C] [III] Other parts [°C]	
18	Class of insulation.	
19	Total creepage distance in (mm)	
20	Maximum radio interference voltage at 1.1 times maximum line to ground voltage (microvolts)	
21	Corona inception and extinction voltage (kv) rms	
22	Partial discharge level (picco coulombs)	
23	Primary.[For 33kV VT]	

	<p>(a) No. of primary turns</p> <p>(b) Material of primary</p> <p>(c) Size of the primary conductor bare/insulated.</p> <p>(d) Cross sectional area of primary conductor (sq.mm)</p> <p>(e) Current density adopted for primary winding (A/sq.mm)</p> <p>(f) Type of primary winding.</p> <p>(g) Name of the insulating materials used for primary conductor.</p> <p>(h) Weight of primary winding.</p>	
24	<p>Secondary. [For 33kV VT]</p> <p>(a) No. of secondary turns</p> <p>(b) Material of secondary</p> <p>© Size of the secondary conductor bare /insulated.</p> <p>(d) Cross sectional area of secondary conductor (mm²)</p> <p>(e) Current density adopted for secondary winding (A/mm²)</p> <p>(f) Type of secondary winding</p> <p>(g) Name of the insulating materials used for secondary conductor.</p> <p>(h) Weight of secondary winding.</p>	
25.	<p>Core. [For 33kV VT]</p> <p>(a) Shape of the core</p> <p>(b) Material and grade of the core laminations</p> <p>(c) Thickness of the core lamination (mm)</p> <p>(d) Maximum flux density adopted (Tesla)</p> <p>(e) Net iron area of the core</p> <p>(f) Watt loss/kg. for the core materials at the operating flux density (W/kg)</p> <p>(g) Total weight of the core (kg)</p> <p>(h) Whether B-H curve for core material enclosed?</p> <p>(i) Whether specific loss vrs. Flux density curve enclosed ?</p>	

26	<p>INSULATION. .[For 33kV VT]</p> <p>(a) Insulation between core and secondaries. (b) Insulation between secondaries. © Insulation between secondary and primary. (d) Insulation between primary .and core.</p>	
27	<p>DIMENSIONS OF CORE AND WINDINGS. .[F or 33kV VT]</p> <p>(a) Diameter of the core (mm) (b) Inner diameter of the secondary windings(mm) (c) Outer diameter of the secondary windings (mm) (d) Inner diameter of the primary winding(mm) (e) Outer diameter of the primary winding(mm) (f) Minimum clearance from primary winding to tank(mm) (g) Minimum clearance from secondary winding to tank(mm)</p>	
28.	<p>Percentage voltage ratio (error)/phase displacement (min.) at 100% rated burden at 0.8PF lagging for measuring winding.</p> <p>a) 80% of rated voltage at frequency:- b) 120% of rated voltage at frequency:- c) Accuracy of standard PT to be used. during determination of errors (0.05 or better.</p>	
29.	<p>Percentage Voltage ratio /phase displacement (min.) at 25% rated burden at 0.8PF lagging for measuring winding.</p> <p>(a) 80% of rated voltage at rated frequency:- (b) 120% of rated voltage at rated frequency:-</p>	
30.	<p>Percentage voltage (ratio)error /phase displacement (min.) at 100% rated burden at 0.8PF lagging for protection winding</p> <p>(a) 5% of rated voltage. (b) 1.2 times rated voltage (c)1.5 times rated voltage (d) 2% of rated voltage..</p>	

31.	Percentage voltage (ratio) error /phase displacement (min) at 25% of rated burden at 0.8PF lagging for protection winding (a) 5% of rated voltage (b) 1.2 times rated voltage. ©1.5 times rated voltage. (d) 2% of rated voltage.	
32.	Whether VT is suitable for horizontal transportation.	
33.	Quantity of oil per VT (Ltrs/kg)	
34.	Standard to which oil conforms.	
35.	Characteristic of oil(Prior to filling)	
35. 1.	Breakdown voltage (kv-rms)	
35. 2.	Dielectric dissipation constant tan delta)	
35. 3	Water content(PPM)	
35. 4	Gas content(PPM)	
35. 5	Interfacial tension at 27 degree C(N/m)	
35. 6	Specific resistance.	
35. 6.1	At 90 deg.C(ohm-cm)	
35. 6.2	At 27 deg.C(ohm-cm)	
36.	Whether VTS are hermetically sealed ? If so how ?	
37.	Total Weight (kg)	
38.	Transport weight (kg)	
39.	Dimensional details.	
40	Whether VT characteristic curves enclosed?	
41.	TANK AND SECONDARY TERMINAL BOX.	
41. 1	Material of the VT tank	
41. 2	Material of the secondary terminal box.	
41. 3	Thickness of the VT tank material.	

41.4	Thickness of the secondary terminal box material.	
41.5	Zinc coating of VT tank(g/sq.m)	
41.6	Zinc coating of the secondary terminal box (g/sq.m)	
41.7	Weather proof rating of secondary terminal box.	
41.8	Weight of tank fitting and other accessories.	
	TERMINAL CONNECTORS	
01.	Manufacturer's name	
02.	Applicable standards.,	
03.	Type.	
04.	Material of connector. a) Clamp body. b) Bolts and Nuts. c) Spring Washers	
05.	Rated current.	
06.	Rated terminal load(kg) Factor of safety.	
07.	Minimum thickness of any part(mm)	
08.	Weight of connector complete with hardware.	
09.	Type test reports as per IS enclosed.	
10.	OGA drawing enclosed.	
	BUSHING/SUPPORT INSULATOR	
01	Manufacturer's name	
02.	Type.	
03.	Applicable standards.	
04	Dimensions: (i)Height(mm) (ii)Diameter(top)(mm) (iii)Diameter(bottom)(mm)	
05	Total creepage distance (mm).	
06.	Rated voltage(KV)(rms)	

07.	Power frequency withstand voltage for (1 minute dry and wet(KV/rms)	
08.	1.2/50 micro-second Impulse withstand voltage (KVP)	
09.	Corona Extinction voltage(kv)	
10.	Weight(kg)	
11.	Maximum allowable span (mm)	
12.	Cantilever strength(kg)	
13.	OGA drawing enclosed.	

ANNEXURE –B.

**CALIBRATION STATUS OF TESTING EQUIPMENTS AND
INSTRUMENTS/METERS.**

Name of the test	Meters and equipments required for the corresponding test with range, accuracy, make and Sl. No.	Date of Calibration.	Due date of Calibration	Name of the Calibrating Agency.	Whether Calibrating Agency is Govt. Approved.
1	2	3	4	5	6

Whether documents relating to Govt. Approval of the calibrating Agency furnished?	Whether the meters/equipments fulfill the accuracy class as per calibration report	Whether the calibrating agency has put any limitation towards the use of the particular meter/equipment. If yes, state the limitations.	Whether green sticker or blue sticker or yellow sticker has been affixed on the body of the particular equipment/meter. State the colour of the affixed sticker.	In spite of imposed limitations, whether the particular meter/equipment can still be used? Justify its use for corresponding test(s).	Remarks
7	8	9	10	11	12

Signature of the tenderer with seal and date.

**ANNEXURE-C
CHECK LIST TOWARDS TYPE TEST REPORTS.**

Name of the Type Test.	Date of Test.	Name of the Laboratory where the Test has been conducted.	Whether the Laboratory is Government Approved.	Whether the Test reports are valid as per Clause No.8.1 of T.S.	Whether the copy of Test Report in complete shape along with drawings etc. furnished or not ?	Whether the Tested I.V.T/ CVT fulfills the technical requirements as per TS.	If the type tested I.V.T/ CVT does not fulfill the technical requirements as per this specification, whether the bidder agrees to conduct the particular test(s) again at their own cost without any financial liability to OPTCL in the presence of OPTCL's representative within the specified delivery period.	Remark
1	2	3	4	5	6	7	8	9

Signature of the tenderer with seal and date.

PART-14
30KV OUTDOOR
LIGHTNING ARRESTER

**TECHNICAL SPECIFICATION FOR 30kV STATION CLASS GAPLESS
METAL OXIDE SURGE ARRESTERS WITH PORCELAIN HOUSING**

1.0 SCOPE:

This specification covers the design, engineering, manufacture, delivery at destination at the discretion of the purchaser of 30kV Metal oxide (gapless) surge arresters with porcelain housing provided with discharge counter, insulating base and other accessories for 33kV system, specified herein for their satisfactory operation in 220/33kV substation for “ M/S. OPTCL ”

2.0 SITE CONDITION:

The surge arrester to be supplied against this specification shall be suitable for satisfactory continuous operation under the following Topographical and Meteorological conditions.

a)	Location	Outdoor
b)	Maximum ambient air temperature (°C)	50
c)	Minimum ambient air temperature (°C)	5
d)	Average daily ambient air temperature (°C)	32
e)	Relative humidity (%)	100
f)	Maximum altitude above mean sea level (m)	<1000
g)	Basic wind speed (m/s)	50
h)	Isokeraunic level (days/year)	70
i)	Seismic level	Zone III as per IS 1893
j)	Degree of Pollution(mm/KV)	31
k)	Site location	Angul. State of ODISHA

3.0 STANDARDS:

3.1 Bidders may please note that surge arrester shall be manufactured, tested and supplied for all guaranteed technical particulars generally conforming to meet the requirement of this technical specification and relevant national standards of India or international electro technical commission standards with latest amendments of relevant standards rules and codes.

Sl.No	Indian Standard	Title	International Standard
1		Metal-oxide surge arresters without gaps for a.c systems	IEC 60099-4
2	IS 3070-3	Surge arresters for alternating current systems- Specification	
3		Surge arresters – Selection and Application recommendations.	IEC 60099-5
4	IS-2629	Recommended practice for Hot dip galvanizing for Iron & Steel	
5	IS 4759	Hot dip zinc-coating on structural steel and other allied products	
6	IS 2633	Method for testing uniformity of coating on zinc coated articles	

7	IS 5561	Specification for Electric Power Connector	
8		Indian Electricity Rules, 1956	
9	IS 2147	Degree of protection provided by enclosures for low voltage switchgears	
10		Metal-Oxide Surge Arresters for AC Power Circuits (> 1 kV)	IEEE std C62.11 -2005
11		Composite hollow insulators – Pressurized and unpressurized insulators for use in electrical equipment with rated voltage greater than 1000 V	IEC 61462

- 3.2 If the equipment offered by Bidders conforms to any other standards, salient points of comparison between the standards adopted and the specific standards shall be clearly brought out in relevant schedule of technical deviation. It will be sole responsibility of Bidders to prove that the salient features of offered equipment are equivalent or better than IS.
- 3.3 The bidder shall also note that list of standards presented in this specification is not complete. Wherever necessary the list of standards shall be considered in conjunction with specific IS/IEC.
- 3.4 When the specific requirements stipulated in the specifications exceed or differ than those required by the applicable standards, the stipulation of the specification shall take precedence.
- 3.5 The equipment conforming to standards other than specified above shall be subject to purchaser approval.

4.0 PRINCIPAL PARAMETERS

The principal parameters shall be as per Annexure 1.

5.0 GENERAL TECHNICAL REQUIREMENT

5.1 The transformer, which is to be protected, has BIL of 170kVp for 33kV system. It shall be possible to achieve proper Insulation Co-ordination with 30kV, Class 3 arresters suitably located.

5.2 The graph for Temporary over Voltage (TOV) capability should be submitted along with the bid.

5.3 ENERGY HANDLING CAPABILITY:

Calculation for energy handling capability should essentially be submitted along with the bid. The calculations should be as per latest version of IEC-60099-4. The energy handling capability for single shot of wave and multiple shots of wave as per IEC should be submitted along with the bid.

5.4 The Surge arrester shall be suitable for Hot line washing.

5.5 SEALING:

Each and every individual unit of surge arrester shall be hermetically sealed and fully protected against ingress of moisture. The hermetic seal shall be effective for entire lifetime of arresters and under the service conditions specified. The bidder shall furnish sectional view showing details of sealing employed. Complete details of sealing arrangement may please be furnished.

5.6 GRADING RING:

The grading ring on each complete arrester may be provided for proper stress distribution either for arrester length exceeds 1.5 to 2 meters or arresters made up of several units.

5.7 PRESSURE RELIEF DEVICE:

The surge arresters shall be fitted with pressure relief devices and arc diverting ports and shall be tested as per the requirements of IEC 60099-Part 4 for minimum prospective symmetrical fault current as specified in Annexure 1.

5.8 INTERCHANGEABILITY:

All the units of arresters of same rating shall be interchangeable without adversely affecting the performance.

5.9 MOUNTING:

a) The surge arresters shall be suitable for pedestal/Gantry type mounting which will be arranged by the purchaser. The mounting of Surge arresters shall be suitable as per structure drawing to be provided by the purchaser.

5.10 PORCELAIN HOUSING:

5.10.1 The ZnO₂ arrester disks/blocks combined with aluminium and electrodes shall be encapsulated in a high strength composite wrap insulating material. The composite collar is cured to the ZnO₂ disk stack to form a solid insulation module system that is inserted and bonded to the track resistant porcelain housing.

5.10.2 The housing shall be moisture ingress proof and capable of withstanding electrical, environmental and cantilever conditions.

5.10.3 The housing shall be resistant to UV degradation and surface tracking. It shall be chemically inert and stable at temperature range.

5.10.4 The housing shall not support biological growth. It shall be non inflammable.

5.10.5 Insulated mounting base shall be provided for connecting up leakage monitor and discharge counter.

5.10.6 Design verification testing covering the following should have been carried out. Test certificates shall be submitted for approval.

1. UV testing
2. Full dielectric testing
3. Wet arc tracking resistance
4. Thermal shock test
5. Multi stress environment test cycle
6. Tracking wheel test
7. Coefficients of expansion for material compatibility
8. Cantilever test

5.10.7 The creepage distance of the arrester housing shall be as stated in Annexure-1

5.10.8 The arrester housing shall conform to the requirements of IEC 60099-4 and IEEE STD C 62.11-2005.

5.11 GALVANISATION, NICKEL PLATING:

i) All ferrous parts exposed to atmosphere shall be (610g/Sq.m) hot dip galvanised as per latest

version of IS: 2629 or equivalent International Standard. Tinned copper/brass lugs shall be used for internal wiring of discharge counter. Screws used for electrical connections shall be either made of brass or nickel-plated steel.

- ii) Ground terminal pads and name plate brackets shall be hot dip galvanised.
- iii) The material shall be galvanised only after completing all shop operations.

5.12 MANUFACTURE OF ZINC OXIDE (ZnO) ELEMENTS:

- a) It is desired that the bidder should have all modern facilities to manufacture zinc oxide discs, with special emphasis on automation of each element of processing of raw materials, mixing of ingredients employed for manufacture of discs, verification of homogeneity of powder mixture, preparation and compression of disc element and stage verification/ testing of disc elements. The bidder must confirm that the process employed for the purpose is fully automatic and should describe all critical stages of manufacture, including the following:
 - a) Batch Mixing
 - b) Batch Grinding
 - c) Batch Homogenizing
 - d) Spray Drying
 - e) Sieving or Sizing
 - f) Sintering
- b) The bidder should also briefly describe the methods adopted and instruments used for measurements to check the quality in following areas as also other important areas during manufacturing process:
 - i. The fineness of material having sub micron size of particles.
 - ii. To measure the particle sizes of input and process materials.
 - iii. Determination of trace impurities in all the metallic oxides.
 - iv. The determination of viscosities of the metal oxide slips during powder preparation.
 - v. To determine the impurity levels of Chlorides, Nitrates and Sulphates as a spot check.
 - vi. To check the porosity and the grain sizes of pressed metal oxide elements.
 - vii. Process of testing of each disc after final finishing.

5.13 Surge Counters:

A self- contained Surge counter, suitably enclosed for outdoor use and requiring no auxiliary of battery supply for operation shall be provided for each unit. The surge counter shall be operated by the discharge current, passed by the surge arrester and shall be suitable for mounting on the support structure of the Arrester.

Surge counters shall be of the Electro-mechanical type and designed for continuous service.

The cyclometer counter shall be visible through an inspection window from ground level. The counter terminals shall be robust and adequate size and shall be so located that the incoming and outgoing connections are made with minimum possible bends.

Internal parts shall be unaffected by atmospheric conditions at site. Alternatively, a weather proof housing to IP 55 shall be provided and this shall be designed to allow the recording device to be read from ground level without exposing the internal parts to the atmosphere.

The Surge Counter shall be connected in the main earth lead from the arrester in such a manner that the direction of the earth lead is not changed or its surge impedance materially altered. A bolted link shall be provided so that the surge counter may be short circuited and removed without taking the arrester out of service. All necessary accessories and earthing connection leads between the bottom of the Arrester and discharge counter shall be in the supplier's scope of supply.

5.14 LEAKAGE CURRENT METERS :

Leakage current meters (suitable milli-ammeter) shall be connected in the earthing path of the surge arresters to measure the resistor grading leakage current. Meters shall be designed for continuous service.

The ammeter shall be suitable for mounting on the support structure of the arrester. The push buttons shall be mounted such that it can be operated from the ground level. The internal parts shall be fully weather - proof to IP 55 or better with a transparent cover to provide an unobstructed view of the ammeter.

5.15 EARTHING:

The Surge arrester shall be provided with two separate earthing terminals for bolted connection to suitable flat or equivalent to be provided by the Purchaser for connection to station earth-mat.

5.16 NAME PLATE:

The arresters shall be provided with non-corrosive legible nameplate indelibly marked with the following information as per IEC – 60099-4.

- i. Order No. & Date
- ii. Manufacturer's name or trademark, type and identification no. of the arresters being supplied.
- iii. Rated voltage
- iv. Maximum continuous operating voltage
- v. Type
- vi. Rated frequency
- vii. Nominal discharge current
- viii. Long duration discharge class
- ix. Pressure relief rated current in kA rms.
- x. B.I.L. of the equipment to be protected.
- xi. Year of manufacture
- xii. Identification of the assembly positions of the unit (For multi unit arresters only).
- xiii. Contaminations withstand level of the enclosure as per IEC 60815.

6.0 TESTS:

6.1 TYPE TEST:

- a) The equipment offered, shall be fully type tested as per IEC 60099- Part 4 or IS 3070-Part 3.
- b) The type test shall be conducted in NABL Accredited laboratory for offered type of Equipment. If offered equipment is already type tested,
- c) For any change in the design / type already type tested and the design/type offered against this bid, the Purchaser reserves the right to demand repetition of same or all type tests without any extra cost.
- d) The following type test reports shall be submitted with the technical bid as per IEC 60099-4.
 1. Insulation withstand tests on the arrester housing
 2. Residual voltage test
 - a) Steep current impulse residual voltage test
 - b) Lightning impulse residual voltage test
 - c) Switching impulse residual voltage test
 3. Long duration current impulse withstand test
 4. Operating duty test
 - a) High – current impulse operating duty test b) Switching surge operating duty test
 5. Short circuit test

6. Internal partial discharge test
 7. Bending moment test
 8. Environmental test
 9. Seal leak rate test
 10. Radio Interference Voltage (RIV) test
 11. Moisture ingress test
 12. Weather ageing test.
 13. Seismic withstand test
 14. IP-66 test on Surge counter
 15. Max. Current operation tests of the surge counter
 16. Max. current withstand test of the surge counter.
- e) The following type test reports shall be submitted with the technical bid as per IEC 61462 for Arrester housing.
1. Bending moment test
 2. Internal Pressure test

6.2 ROUTINE AND ACCEPTANCE TESTS:

- i. The manufacturer shall carry out all acceptance and routine tests as per IEC 60099- Part 4 or IS 3070-Part 3 in presence of Purchaser's representative.
- ii. Immediately after finalization of the programme of type/ acceptance/ routine testing, the manufacturer shall give sufficient advance intimation to the Purchaser, to enable him to depute his representative for witnessing the tests.
- iii. Acceptance tests, whenever possible shall be conducted on the complete arrester unit. The number of samples to be subjected to acceptance tests shall be decided by the purchaser at the time of actual testing.
- iv. The special thermal stability test shall be carried out as acceptance test.
- v. The functional (operational) acceptance tests shall be carried out on the surge counter by way of checking its operation at following nominal discharge currents
 - a) 100 Amps with 8/20 microsecond wave shape
 - b) 10 kA with 8/20 microsecond wave shape.
- vi. The following Routine tests shall be done on the Surge arrester.
 1. Measurement of reference voltage
 2. Lightning Impulse Residual voltage test
 3. Internal Partial discharge test
 4. Seal Leakage check test
 5. Current distribution test
 6. Watt loss test
 7. Tests on discharge counter
 8. Visual / Dimensional check
 9. Special Seal leakage test for duration of 24 hrs to check the water penetration, on any one randomly selected sample from every 50 or below nos. of LA offered for inspection, shall be carried out and report shall be submitted.
- vii. The Following Acceptance tests shall be carried out in the presence of purchaser's representative.
 1. Power frequency voltage withstand test
 2. Lightning Impulse residual voltage test on complete arrester / unit of arrester
 3. Reference voltage test
 4. Seal Leakage check test
 5. Partial discharge test

6. Visual / Dimensional check
7. Special thermal stability test
8. Galvanization test on metal parts
9. Functional (operational) tests on surge monitor/counter at nominal discharge currents
 - i. 100 Amps with 8/20 microsecond wave shape.
 - ii. 10 KA with 8/20 microsecond wave shape.
10. Special Seal leakage test for a duration of 24 hrs, to check the water penetration, on any one randomly selected sample from every 50 (Fifty) or below nos. of LA offered for Inspection, shall be carried out and report shall be submitted.

7.0 INSPECTION:

- i. The Purchaser shall have access at all times to the works and all other places of manufacturer, where the arresters are being manufactured and the bidder shall provide all facilities for unrestricted inspection of the Bidder's works, raw materials, manufacture of all the accessories and for conducting necessary tests as detailed herein.
- ii. The successful Bidder shall keep the Purchaser informed in advance of the time of starting and of the progress of manufacture of equipment in its various stages, so that arrangements could be made for inspection.
- iii. No material shall be dispatched from the point of manufacture unless the material has been satisfactorily inspected and tested.
- iv. The acceptance of any quantity of the equipment shall in no way relieve the successful bidder of his responsibility for meeting all the requirement of this specification and shall not prevent subsequent rejection if such equipment are later found to be defective.

8.0 QUALITY ASSURANCE PLAN & STAGE INSPECTION:

- 8.1 The bidder shall ensure that for the purpose of supply of equipment, the manufacturer will have to follow strict quality assurance programme, which will include thorough verification of samples of critical assemblies and accessories, verification of sources of raw materials, detailed verification of drawing & design, checking up of relevant calculations, stage inspections at various critical stages of manufacture and minor modifications consequent to such stage inspections as per our requirements and all other related requirements, which have generally been brought out in bidding documents and the detailed contract. It is expected that bidder would be very serious and prudent in meeting these requirements without any loss of time, so that supply of equipment in line with quality assurance programme is ensured within targeted schedule.
- 8.2 Purchaser reserves the right to specify various stages for stage inspections and also for manufacture of a proto type unit for inspection & testing, before according clearance for bulk manufacturing. The bidder shall ensure that they are following a proper quality assurance programme for manufacture of offered equipment.
- 8.3 The bidder shall ensure that manufacturer invariably furnish following information:
 - i. Statement giving list of important raw materials, names of sub supplier for the raw material, list of standards according to which the raw material are tested, list of tests normally carried out on raw material in presence of manufacturers representative, copies of test certificates.
 - ii. Information and copies of test certificates as in (i) above in respect of bought out items.
 - iii. List of manufacturing facilities available.
 - iv. Levels of automation achieved and list of areas where manual processing exists.
 - v. List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspection.

- vi. Special features provided in the equipment to make it maintenance free.
 - vii. List of testing equipment available with the manufacturer for final testing of equipment specified and test plant limitations, if any vis-à-vis type, special, acceptance and routine tests specified in the relevant Indian Standards or equivalent international standard. These limitations shall be very clearly brought out in schedule of deviations from specified test equipment.
- 8.4 The successful bidder shall arrange the following information to Purchaser within 30 days of award of Contract.
- i. Quality Assurance Plan (QAP) with hold points for purchaser's inspection. The quality assurance plans and holds points shall be discussed between purchaser and bidder before the QAP is finalized. The successful Bidder shall also ensure that the manufacturer submits the routine test certificates of bought out items and for raw material at the time of routine testing of the fully assembled equipment.
- 9.0 LIST OF DRAWINGS AND DOCUMENTS:**
- 9.1** Tenderer is advised to submit OPTCL approved copy of following drawings of the type offered for proper evaluation.
- i. General outline drawings of complete Surge arrester with technical parameters.
 - ii. The detailed dimensional drawing of arrester housing such as ID, OD, thickness and insulator details such as height, profile of petticoats, angle of inclination & gap between successive petticoats, total creepage distance etc.
 - iii. Rating & Diagram Plate.
 - iv. Sectional view to explain pressure relief arrangement.
- 9.2** After receipt of the order, the successful Tenderer will be required to submit the following drawings for approval:-
- a. General outline drawings of complete Surge arrester with technical parameters.
 - b. Drawings showing clearance from grounded and other live objects and between adjacent poles of Surge arresters required at various heights of Surge arresters.
 - c. Drawing showing details of pressure relief device.
 - d. Detailed drawing of discharge counters along with the wiring and schematic drawing of discharge counters & meters.
 - e. Details of grading rings if used.
 - f. Outline drawing of insulating base.
 - g. Mounting details of Surge arresters.
 - h. Details of the line terminal connector and ground terminals.
 - i. Details and dimensions of ZnO blocks.
 - j. Volt time characteristics of Surge arresters.
 - k. Details of galvanising being provided on different ferrous parts.
 - l. The detailed dimensional drawing of arrester housing such as ID, OD, thickness and insulator details such as height, profile of petticoats, angle of inclination & gap between successive petticoats, total creepage distance etc.
 - m. Name plate drawing.
 - n. Sectional view of sealing arrangement and pressure relief device.
 - o. Literature, pamphlets of the bought out item and raw material.

- 9.3** The successful Bidder shall within two weeks from signing of contract, submit all the above drawings for Purchaser's approval. The Purchaser shall communicate his comments/ approval

- on the drawings to the Bidder within reasonable time. The Bidder shall, if necessary, modify the drawings and resubmit four copies of the modified drawings for Purchaser's approval within two weeks from the date of Purchaser's comments. After receipt of Purchaser's approval, the Bidder shall within three weeks submit good quality reproducible (Soft copy) of the approved drawings for Purchaser's use.
- 9.4** The manufacturing of the equipment shall be strictly in accordance with the approved drawings and no deviation shall be permitted without the written approval of the Purchaser. All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawing shall be at the Bidder's risk.
- 9.5** The bidder shall submit neatly printed and bound two volumes of operation, maintenance and erection manuals in English Language, for each type and rating of equipment supplied for distribution, along with the equipment. The manual shall contain all the drawings and information required for erection, operation and maintenance of the equipment. The manual shall also contain a set of all the approved drawings and type test reports etc.
- 9.6** Approval of drawings by Purchaser shall not relieve the Bidder of his responsibility and liability for ensuring correctness and correct interpretation of the latest revision of applicable standards, rules and codes of practices. The equipment shall conform in all respects to high standards of engineering, design, workmanship and latest revisions of relevant standards at the time of ordering and Purchaser shall have the power to reject any work or material, which in his judgment is not in full accordance therewith.
- 10.0 PACKING & FORWARDING:**
- 10.1** Bidder shall ensure that the equipment shall be packed in crates suitable for vertical/horizontal transport, as the case may be and suitable to withstand handling during transport and outdoor storage during transit. The easily damageable material shall be carefully packed and marked with the appropriate caution symbols. Wherever necessary, proper arrangement for lifting such as lifting hooks etc. shall be provided. Any material found short inside the packing cases shall be supplied by supplier without any extra cost.
- 10.2** Components containing glass shall be carefully covered with shock absorbing protective material such as Thermocol. All opening in the equipment shall be tightly covered, plugged or capped to prevent dust and foreign material from entering in. All spares parts shall be packed and crated for long storage conditions at site.

ANNEXURE - 1

Sl.No	Description	Particulars
1	Nominal system voltage(kV)	33
2	Highest system voltage(kV)	36
3	Rated arrester voltage(kV)	30
4	Maximum continuous operating voltage(kV)	25
5	Temporary overvoltage capability(kVp)	
	a) 0.1 s	53
	b) 1 s	51
	c) 10 s	49
	d) 100s	47
6	Nominal discharge current corresponding to 8/20 μ s wave shape (kA)	10
7	Minimum energy discharge capability (as per long duration discharge class of IEC- 99-4) in kJ/kV	5
8	Long duration discharge class	III
9	Maximum residual voltage at nominal discharge current of 8/20 micro sec. wave for 10 kA (kV peak)	
	a) 5 kA	85
	b) 10kA	90
	c) 20 kA	100
10	Neutral Grounding	Effectively Earthed
11	Lightning Impulse voltage withstand level	
	a) For Power Transformer(kVp)	170
	b) Other equipment & lines(kVp)	
12	Power frequency withstand level	
	c) For Power Transformer(kV rms)	70
	d) Other equipment & lines(kV rms)	
13	Minimum prospective symmetrical fault current for pressure relief test(kA rms)	40
14	Creepage distance (mm)	1116
15	Pressure relief device.	Class A
16	Insulation level of housing (Lightning Impulse withstand voltage) (kVp)	170
17	Max. Cantilever strength of the arresters (KGM) for 1 minute withstand	150
18	Max. deflection at above cantilever in mm	200
19	Housing material	porcelain
20	Installation	Outdoor
21	RIV at 92kV rms	Less than 500 micro volts

ANNEXURE - 2

GUARANTEED TECHNICAL PARTICULARS

S.No	Description	Parameters
1	Name of Manufacturer	
2.	Arrester Class & Type (with Mfr type designation)	
3.	Applicable Standard.	
4.	Nos. of unit per phase	
5.	Nos. of ZnO blocks per unit	
6.	Rated Arrester Voltage (kV) of complete unit	
7.	Rated system voltage (kV)	
8.	Max continuous operating voltage (MCOV) - (kV)	
9.	Watt- loss at continuous operating voltage (watt/kV)	
10.	Watt- loss at Rated voltage (watt/kV)	
11.	i) Nominal Discharge Current (kA) with 8/20 μ s	
	ii)Max resistive component of continuous current at MCOV - mA crest	
	iii)Max capacitive component of continuous current at MCOV - mA crest	
12.	Leakage current at C.O.V (mA)	
13.	Leakage current at rated voltage (mA)	
14.	Long duration current impulse rating a) Peak current (A) b) Virtual duration of peak (μ s)	
15.	Long Duration Discharge Class	
16.	Minimum energy discharge capability (kJ/kV rating) as per IEC	
17.	Maximum switching current impulse residual voltage (kV _p)	
	i) 1000 Amps.	
	ii) 250 Amps.	
18.	Maximum residual voltage for discharge current of 8/20 μ s (kV _p)	
	i)5000A	
	ii) 10000A	
	iii) 20000A	
19.	Steep current Impulse residual voltage test with 1 μ s front time current wave of 10kA peak (kV _p)	
20.	Minimum prospective symmetrical fault current for pressure relief test	
21.	Pressure relief class kA(rms)	
22.	Lightning impulse withstand voltage of arrester housing with 1.2/50 μ s wave (kV _p)	
23.	One minute power frequency withstand voltage of housing (dry /wet) - kV (rms)	

S.No	Description	Parameters
24.	Maximum RIV at continuous operating voltage.(μv)	
25.	High current short duration impulse withstand level with 4/10 μs wave (kAp)	
26.	Over voltage withstand capability-kV	
	100 s	
	10 s	
	1.0 s	
	0.1 s	
27.	a) Reference voltage (kV)	
	b) Reference current(kA)	
28.	Number of units per phase and rating of each unit	
29.	Minimum total creepage distance	
30.	Acceptable partial discharge level at U_m voltage	
31.	Total weight of arrester (kg)	
32.	Maximum cantilever strength of Surge arrester (Including wind load)	
33.	Overall height of Arrester (mm)	
34.	Cantilever strength of assembled arrester (kgm)	
35.	Maximum distance recommended from equipments to be protected by surge arrester (mm)	
36.	Minimum distance between arrester phase legs (mm)	
37.	Details of Metal Oxide block	
	a. Reference voltages	
	b. Material	
	c. Diameter	
	d. height	

Note:

No Deviation from technical particulars of equipments and materials will be allowed, which may please be noted.

PART-15
33kV BUS POST INSULATOR

TECHNICAL SPECIFICATION FOR 33KV SOLID CORE POST INSULATOR

1.0 SCOPE:

The scope covers design, engineering, manufacturing, assembly and supply of 33kV Solid core post insulators for 220/33kV substation for "M/S. OPTCL." herein after referred to as "Purchaser".

It is not the intent to specify completely here all the details of design and construction of the equipment. However, the equipment shall conform in all respects to the high standard of engineering design and workmanship and shall be capable of performing in continuous commercial operation in a manner acceptable to the Purchaser. The equipment offered shall be complete with all components necessary for their effective and trouble free operation.

2.0 SITE CONDITION:

The surge arrester to be supplied against this specification shall be suitable for satisfactory continuous operation under the following Topographical and Meteorological conditions.

a)	Location	Outdoor
b)	Maximum ambient air temperature (°C)	50
c)	Minimum ambient air temperature (°C)	5
d)	Average daily ambient air temperature (°C)	32
e)	Relative humidity (%)	100
f)	Maximum altitude above mean sea level (m)	<1000
g)	Basic wind speed (m/s)	50
h)	Isokeraunic level (days/year)	70
i)	Seismic level	Zone III as per IS 1893
j)	Degree of Pollution(mm/KV)	31
k)	Site location	Angul. State of ODISHA

3.0 STANDARDS

3.1 Bidders may please note that equipment offered shall be manufactured, tested and supplied for all guaranteed technical particulars generally conforming to meet the requirement of this technical specification and relevant national standards of India or international electro technical commission standards with latest amendments of relevant standards rules and codes.

Indian Standards	Title	IEC Standards
IS-2544	Porcelain post insulators for systems with nominal voltage greater than 1000 Volts.	IEC 60168 & IEC 60273
IS-5350	Dimensions of indoor and outdoor porcelain post insulators and post insulator units for systems with nominal voltage greater than 1000V	-
IS 2009	Specification for bushings for alternating voltages above 1000V	IEC 60137

IS 7648	Specification for silicone compounds for application on high voltage porcelain insulators	-
IS 8263	Method for radio interference test on high voltage insulators	-
IS 8269	Methods of switching impulse tests on high voltage insulators	-
IS 8704	Artificial pollution test on high voltage insulators to be used on AC systems	-
IS 2629	Recommended Practice for Hot dip galvanized Iron & steel	-
IS 2633	Method for Testing uniformity of coating of Zinc Coated articles	-
IS 6735	Fasteners – Spring lock washers for screws with cylindrical heads.	-
IS 2016	Plain Washers	-
IEC 71	Electrical Clearances	-

- 3.2 If the equipment offered by Bidders conforms to any other standards, salient points of comparison between the standards adopted and the specific standards shall be clearly brought out in relevant schedule of technical deviation. It will be sole responsibility of Bidders to prove that the salient features of offered equipment are equivalent or better than IS.
- 3.3 The bidder shall also note that list of standards presented in this specification is not complete. Wherever necessary the list of standards shall be considered in conjunction with specific IS/IEC.
- 3.4 When the specific requirements stipulated in the specifications exceed or differ than those required by the applicable standards, the stipulation of the specification shall take precedence.
- 3.5 The equipment conforming to standards other than specified above shall be subject to purchaser approval.
- 3.6 The 33kV Solid core Post insulator shall have the technical particulars as per Annexure-I. Particulars which are subject to guarantee shall be furnished along with the bid. Any other particulars considered essential may please also be furnished in the guaranteed technical particulars.

4.0 PRINCIPAL PARAMETERS:

The principal parameters shall be as per Annexure 1

5.0 MECHANICAL STRENGTH:

- i) Cantilever strength : 8kN
- ii) Tensile Strength : AS PER IS 5350/ IEC 60273
- iii) Compression Strength : AS PER IS 5350/ IEC 60273

6.0 DESIGN & TYPE:

1. The porcelain used for the manufacture of the insulators should be homogenous, free from laminations and other flaws or imperfections which might affect the mechanical or dielectric quality. These should be thoroughly verified, tough imperative to non-impress of moisture.
2. The glazing of the porcelain should be of uniform brown colour, free from blisters, burns and similar other defects.

3. The total fittings for the insulated material made from reliable cast iron or grey iron and galvanised thereafter. Cementing between metal to porcelain should be carried out by high grade port land cement with special filler to check the expansion and contraction problem.
4. The metal cement porcelain joints should be painted with suitable paints to offer protection against different thermal expansions.
5. The insulator units shall be such that the length of shortest breakdown path through valid insulating material is at least equal to half the length of the short break down path through air outside the insulator.
6. Post Insulator shall be suitable for mounting in Lattice type support structure. Support structure is not in bidder scope of supply and it shall be supplied by the purchaser.

7.0 CREEPAGE DISTANCE:

The minimum nominal specific Creepage distance should not be less than 1116 mm as applicable for heavily polluted atmosphere as per latest edition of IS-2544/IEC 60815 as per provisions made in IEC-60815, in order to apply the specific Creepage distance concept certain dimensional parameters characterizing the insulator should be taken into account, which relates to the shed/shape to the profile of the insulator. The Bidder should therefore give full detail of shed/shape/profile of the insulator (for vertically used insulators) to safeguard the requirement of projected profile/protected creepage distance. As per above provisions the insulator may be type tested for heavy polluted atmosphere conditions and the type test report may be submitted with the offer. This requirement is very vital, and equipments not meeting the minimum requirements shall not be acceptable.

8.0 DESIGN, MATERIAL AND WORKMANSHIP:

The successful Bidder should assume full responsibility for co-ordination with insulator manufacturer and adequate design. All materials used in the construction of the equipment shall be of appropriate class, well finished and of approved design and make. All similar parts should be accurately finished and interchangeable. All ferrous parts should be heavily hot dip galvanized as per relevant IS Bolts, nuts, pins and washers etc. used should also be galvanized. Special attention should be paid to give tropical treatment to all the equipment as it will be subjected during service to extremely severe exposure to atmospheric moisture and long period of high ambient temperature.

9.0 GALVANISING:

All metal parts of insulators shall be made of forged steel and shall be hot dip galvanized after all machining work in accordance with the latest edition of IS 2629-1964 and shall satisfy the test mentioned in IS 2633:1964. The galvanized material shall be guaranteed to withstand at least six dips under the standard test galvanizing. The zinc operating shall be adherent, smooth, reasonably bright continuous and free from such imperfections such as flux, ash, rust, strains, bulky, white deposit and blisters etc. All surfaces of the metal parts shall be relatively smooth with no projecting points or irregularities. Insulators units after assembly shall be concentric and coaxial within limits as may be permissible by the relevant IS/IEC.

10.0 BOLTS AND NUTS FOR FIXING TOP AND BOTTOM:

Bidder shall quote their price including the prices of nuts and bolts but will give technical specification of the recommended size of bolts and nuts for fixing top and bottom and any intermediate point.

11.0 TEST & TEST CERTIFICATES:

11.1 TYPE TEST:

1. The equipment offered, shall be fully type tested as per IS 2544 or IEC 60168
2. The type test shall be conducted in NABL Accredited laboratory for offered type of equipment.

3. For any change in the design / type already type tested and the design/type offered against this bid, the Purchaser reserves the right to demand repetition of same or all type tests without any extra cost.
4. In the event of order for supply of equipment, the bidder has to furnish following type test reports for approval:
 - a) Visual discharge test.
 - b) Verification of dimensions.
 - c) Visual examination test
 - d) Impulse voltage withstand test.
 - e) Dry and wet 1 minute power frequency withstand test.
 - f) RIV test.
 - g) Puncture test.
 - h) Porosity test.
 - i) Temperature cycle test.
 - j) Test for mechanical strength.
 - k) Galvanizing test.
 - l) Artificial pollution test.

11.2 ACCEPTANCE TEST:

The following sample tests as per IS 2544/IEC 60168 shall be conducted.

- a) Verification of dimensions.
- b) Temperature cycle test.
- c) Test for mechanical strength.
- d) Puncture test.
- e) Galvanizing test.
- f) Porosity test.
- g) In addition to above sample test the total creepage measurement test shall also be conducted.

Total Creepage Measurement Test:

The creepage distance of each unit shall be measured by applying a thin inextensible cord along with shortest distance from the upper metal fitting to the lowest metal fitting, the cord to be in contact with the external surface of the unit. The total creepage distance shall be obtained by adding the values obtained above for the relative units and shall be not less than the value nominated under minimum 'Total creepage Distance' in clause above.

11.3 ROUTINE TESTS:

The following routine tests as contained in IS2544/ IEC-60168 shall be performed by the Bidder on each insulator.

- a) Visual examination test.
- b) Electrical routine test.
- c) Mechanical routine test.
- d) In addition to above routine, the Flaw detection test and High frequency voltage dry flashover test shall also be conducted as follows :-

Flaw Detection Test:

Every porcelain body of the insulator to be supplied shall be tested before assembly with Ultrasonic wave or by other approved means to detect any possible voids, crack, porosity or similar defects. The Bidder submitting a quotation shall describe in detail the proposed method of carrying out this test. As longitudinal ultrasonic testing is possible only on unassembled insulators, it is the responsibility of the Bidder to ensure that, if using the ultrasonic method this test be conducted before cementing the

metal fittings on the porcelain and be directed from both ends of the porcelain.

High Frequency Voltage Dry Flashover Test:

Every porcelain part of the insulator shall be set up between suitable terminals and subjected to a high frequency (200 or more KHz) voltage sufficient to cause vigorous flashover. The flashover shall be maintained for period of not less than three seconds without puncturing the porcelain.

12.0 LIST OF DRAWINGS AND DOCUMENTS:

12.1 Bidders are advised to submit approved copy of GA drawings of the type offered for proper evaluation.

12.2 After receipt of the order, the successful Bidder will be required to submit the following drawings for approval:-

- a) General outline drawings of the equipment.
- b) Shed profile
- c) Top & Bottom Shell details
- d) Top , Intermediate and Bottom Flange details

12.3 The successful Bidder shall within two weeks from signing of contract, submit all the above drawings for Purchaser's approval. The Purchaser shall communicate his comments/ approval on the drawings to the Bidder within reasonable time. The Bidder shall, if necessary, modify the drawings and resubmit four copies of the modified drawings for Purchaser's approval within two weeks from the date of Purchaser's comments. After receipt of Purchaser's approval, the Bidder shall within three weeks submit good quality reproducible (Soft copy) of the approved drawings for Purchaser's use.

12.4 The manufacturing of the equipment shall be strictly in accordance with the approved drawings and no deviation shall be permitted without the written approval of the Purchaser. All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawing shall be at the Bidder's risk.

12.5 Approval of drawings by Purchaser shall not relieve the Bidder of his responsibility and liability for ensuring correctness and correct interpretation of the latest revision of applicable standards, rules and codes of practices. The equipment shall conform in all respects to high standards of engineering, design, workmanship and latest revisions of relevant standards at the time of ordering and Purchaser shall have the power to reject any work or material, which in his judgment is not in full accordance therewith.

13.0 QUALITY ASSURANCE PLAN:

13.1 The Bidder must establish that they are following a proper quality assurance programme for manufacture of equipment. The Bidder shall invariably furnish following information along with his offer. Information shall be separately given for individual type of equipment offered.

- i. Statement giving list of important raw materials, names of sub supplier for the raw material, list of standards according to which the raw material are tested, list of tests normally carried out on raw material in presence of Bidder's representative and copies of test certificates.
- ii. Information and copies of test certificates as mentioned in (i) above in respect of bought out items.
- iii. List of manufacturing facilities available.
- iv. Level of automation achieved and list of areas where manual processing exists.
- v. List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspection.
- vi. Special features provided in the equipment to make it maintenance free.

- vii. List of testing equipment available with the Bidder for final testing of equipment specified and test plant limitations, if any vis-à-vis type tests, acceptance and routine tests specified in the relevant Indian Standards or equivalent international standard. These limitations shall be very clearly brought out in schedule of deviations from specified test equipments.

13.2 The successful Bidder shall submit following information to the Purchaser.

- i. List of raw materials as well as bought out accessories and the names of sub supplier selected from the lists furnished along with offer.
- ii. Type test certificate of the raw material and bought out accessories.
- iii. Quality Assurance Plan (QAP) with hold points by Purchaser's inspection. The quality assurance plans and hold points shall be discussed between the Purchaser and Bidder before the QAP is finalized.

13.3 The successful Bidder shall submit the routine test certificates of bought out items and for raw material at the time of routine testing of the fully assembled equipment.

14.0 INSPECTION:

- i. The Purchaser shall have access at all times to the works and all other places of manufacture, where the equipment are being manufactured and the Bidder shall provide all facilities for unrestricted inspection of the manufacture's works, raw materials, manufacture of all the accessories and for conducting necessary tests as detailed herein. Purchaser reserves the right to insist for witnessing the acceptance/routine testing of the bought out items. Bidder shall submit the routine test certificates of bought out items and raw material, at the time of routine testing of the fully assembled equipment.
- ii. The successful Bidder shall keep the Purchaser informed in advance of the time of starting and of the progress of manufacture of equipment of the various stages, so that arrangements could be made for inspection.
- iii. No material shall be dispatched from its point of manufacture unless the material has been satisfactorily inspected and tested. Successful Bidder shall within 30 days of placement of order, submit list of bought out accessories and the names of sub-suppliers.
- iv. The acceptance of any quantity of the equipment shall in no way relieve the successful bidder of his responsibility for meeting all the requirements of this specification and shall not prevent subsequent rejection if such equipment is later found to be defective.
- v. In case for any reasons inspection is not completed or equipment is not found to be complete with all accessories as per confirmation given with the letter of inspection call, Purchaser will reserve the right to recover the complete cost of deputation of inspecting team to the works of the manufacturer.

15.0 ENGRAVING, PACKING AND FORWARDING:

15.1 The details such as order no. and date, year of manufacture should be engraved on equipment. The equipment shall be packed in crates suitable for vertical/ horizontal transport, as the case may be and suitable to withstand handling during transport and outdoor storage during transit. The Bidder shall be responsible for any damage during transit, due to improper and inadequate packing and handling. The easily damageable material shall be carefully packed and marked with the appropriate caution symbols. Wherever necessary, proper arrangement for lifting, such as lifting hooks etc., shall be provided. Bidder shall supply, any material, found short inside the packing cases without any extra cost.

15.2 Components containing glass shall be carefully covered with shock absorbing protective material such as Thermacole. All opening in the equipment shall be tightly covered, plugged or capped to prevent dust and foreign material from entering in. All spares parts shall be packed and crated for long storage conditions at site.

15.3 Each consignment shall be accompanied by a detailed packing list containing the following information:

- a) Name of the consignee.
- b) Details of consignment.
- c) Destination
- d) Total weight of consignment.
- e) Handling and unpacking instructions.
- f) Bill of material indicating contents of each package.

15.4 The Bidder shall ensure that the packing list and bill of material is approved by Purchaser before dispatch.

16.0 COMPLETENESS OF EQUIPMENT AND BOUGHT OUT ITEMS:

16.1 Bid shall be complete in all respects and shall include all minor component, accessories, small wiring etc., not specifically mentioned in the Schedule, specifications etc; but essential for the completeness of the system. Bidders shall not be eligible for extra charges in respect of such minor components, accessories, small wiring etc., though not included specifically in this specification but requires for satisfactory operation of equipment offered.

16.2 Bidders must furnish following information along with technical Bid.

- i. Complete details of all the accessories which will be supplied.
- ii. It is obligatory on the part of bidders to ensure that supplies of all accessories along with Main equipment are simultaneously delivered to avoid any holdups. Responsibility for obtaining timely supplies of bought out items will rest on the bidders and only on this basis, delivery period will be offered in the Bid.
- iii. It may be noted that in case of damages/ shortages due to improper packing or any other negligence, replenishment shall be arranged within one month's time. For bought out items, responsibility for guarantee and obtaining immediate replacement in case any defects are noticed and also in case defective supply of any item is reported, will rest on the bidders.

ANNEXURE- I

GURANTEED TECHNICAL PARTICULARS

Sl.No	Rated voltage	Required	Provided
1	Make	Bidder to specify	
2	Type	Solid core, Type A	
3	Cantilever strength of stack	Bidder to specify	
4	Number of units per stack	Min. 1	
5	Dry arcing distance	Bidder to specify	
6	Nominal System Voltage (kV)	33	
7	Highest System Voltage (kV)	36	
8	Dry/Wet power frequency withstand voltage (kV)	95/80	
9	Lightning impulse withstand voltage. (kV peak)	170	
10	+ve / -ve Impulse flashover voltage (kVp)	210/225	
11	Dry/Wet power frequency flashover voltage (kV)	125/100	
12	Cantilever strength (kN)	8	
13	Compressive strength (Kgf)	Bidder to specify	
14	Torsional strength (kgfm)	Bidder to specify	
15	Tensile strength (kgf)	Bidder to specify	
16	Corona extinction voltage (kV)	27	
17	Max. RIV at 1.1 Um/ /3 kV, rms (micro volts)	1000	
18	Creepage distance (mm)		
	a. Total	1116(Min.)	
	b. Protected	Bidder to specify	
19	Dimensional details		
	i. Length (mm)	508	
	ii. Diameter of shed (mm)	Bidder to specify	
	iii. Weight (mm)	Bidder to specify	
	iv. PCD top flange (mm)	76	
	v. PCD bottom flange (mm)	76	
	vi. Depth of threaded portion of top bolt PCD in (mm)	Bidder to specify	
	vii. No. & dia of bolts for top fixing (mm)	Bidder to specify	
	viii. No. & dia of bolts for bottom fixing (mm)	Bidder to specify	

Part-16
LT SWITCHGEAR

DISTRUBUTION BOARDS

- 1) ACDB
- 2) DCDB
- 3) OTHER CONSOLES INCLUDING BMK

TECHNICAL SPECIFICATION FOR DISTRIBUTION BOARDS

1. GENERAL:-

Requirements of AC and DC systems:

The electrical auxiliary systems shall be of a quality commensurate with the performance, reliability and availability requirements of the substation.

The electrical station services shall be in accordance with all the relevant standards, shall satisfy the requirements specified herein and shall be designed to operate in the environmental conditions specified in the relevant sections of this Specification.

The electrical station systems shall be required to provide the voltage classes indicated in Table 1.1. for operation of various plant equipment operating mechanisms, plants, control and communication systems

Nominal Voltage V	Tolerance	Frequency Hz or DC	Phases	Wires	Neutral Connection
430	±10%	50±5%	3	4	Solidly earthed
240	±10%	50±5%	1	2	Solidly earthed
220	187V to 242V	DC	DC	2	Isolated 2 wires
50	±10%	DC	DC	2	+ve earthed

Table 1.1. Voltage classes

The auxiliaries shall be capable of withstanding all over frequency and under voltage conditions without loss of supply to the power circuits or shutdown of any auxiliary system meeting the essential loads of the substation plant and equipment.

Configuration:

The basic design of the substation electrical auxiliary services shall be as shown in the schematic drawing. This drawing is for guidance only and the Contractor may propose an alternative keeping in view the design philosophy stipulated in this section of the Specification. The design philosophy for auxiliary supply systems shall be as follows:

- a) The AC supply for station auxiliary systems shall generally be obtained from a single source from the local distribution network having a track record of good power availability. For 220kV substations two separate sources shall be used.

Where 33kV bus bars are available at the substation site station auxiliary transformers shall be installed to provide reliable auxiliary power supplies. At least two auxiliary transformers of a rating sufficient to feed the substation load shall be installed. Where specified, in order to meet the station essential

loads a back-up supply from a standby diesel generator set shall be provided. The requirement of diesel generator sets have been indicated in the bill of quantity of relevant schedules.

b) The Contractor shall estimate loads of the substation and determine the required capacity of station auxiliary transformers and diesel generator set and submit same for the approval of the Project Manager. The contractor shall classify the loads based on the principles defined in the following clauses.

Load Classes:

Essential loads:

These are loads whose failure will affect the capability of the station and station plant and equipment. These loads shall include cooling and other auxiliaries of transformers and reactors, non-interruptible power units, auxiliaries of reactive power compensator, and station services of the relays in the substation.

Emergency loads:

These are loads that must remain in service during complete loss of the ac power supply. These loads shall include the station battery chargers, disconnecting switch and circuit breaker operating mechanisms, control room air-conditioning and the emergency lighting of the switchyard and control building. Some emergency loads operate on ac voltage and the others on dc voltage.

Normal loads:

This load, whose failure does not affect capability, shall include but not be limited to control building and switchyard lighting, control building air-conditioning except in control room, air compressors, normal and fire-fighting water pumps, oil treatment loads, etc.

Basic design criteria:

The failure or the disconnection for maintenance of any motor, feeder, motor control centre, or 415V power centre or auxiliary transformer shall not affect the power transmission capability of the substation.

To achieve the above criteria, the following facilities shall be incorporated, by the Contractor, in the design of the auxiliary systems:

1. Highly reliable duplicate primary supply sources, with automatic change-over facilities.
2. Duplicate essential loads (e.g. cooling pumps, fans, heat exchangers, etc.). Duplicated loads shall be supplied from two different 430VAC distribution boards (ACDB). Essential loads which are not duplicated shall have duplicated supply circuits with the source having auto change over facility.

3. Provision of a diesel generator set for the essential loads. The generator shall start up automatically, in case of loss of all normal and stand by supplies, to feed the essential loads and emergency loads.
4. In order to limit fault currents, to prevent back feed into the AC bus, and to ensure independence of supply sources, parallel operation between station service transformers shall not be permitted at any voltage level. Also parallel operation shall not be permitted between transformers and diesel generator.
5. System shall be clear and simple to operate to minimise the risk of loss of supply due to human error.
6. The Contractor shall design the LV distribution system to ensure that the voltage supply limits are maintained at all times and that the switchboards and cabling are never overloaded. On larger stations it may be necessary to supply more than one main LVAC switchboard.

415V AC distribution system:

General:

The 430V secondary distribution system shall comprise 430V power centers serving the different classes of loads either directly or through motor control centers.

Each power center shall consist of two sections, supplied through two station service transformers of adequate capacity. Each transformer and each section of the 430V power center shall be designed to carry the total load of both sections. The two sections shall be interconnected through normally open bus tie breakers and normally closed fuse disconnects. An automatic transfer scheme shall be incorporated within each power center. This transfer scheme shall automatically disconnect the voltage deficient bus and then re-energizes it from the healthy bus.

Restoration of normal supply conditions shall automatically return the power center to the normal operating mode. The 430V power centers shall be of the metal enclosed switchgear type according to the relevant IEC or Indian Standards.

AC distribution board:

The ACDB's shall be in accordance with the relevant IEC or Indian Standards and shall also comply with the following requirements:

- The ACDB shall be located near the supplied loads or inside the control room at a suitable place.
- The circuit breakers of the ACDB shall be individually interlocked to prevent paralleling of two buses from two different sources.
- The 240V loads shall be supplied by 240V panels located in the ACDB room or outside where it is required.

Supply of essential loads:

Essential loads shall be fed from ACDB-1 and ACDB-2 respectively. A diesel generator set shall be connected as indicated in schematic drawing so as to meet the complete requirement of the essential loads of the substations. ACDB's shall be independently fed from two different sections of the main distribution board.

Supply of emergency loads:

The emergency loads shall also be supplied from essential bus ACDB-1, ACDB-2, 220V DCDB-1 and 220V DCDB-2, and 50V DCDB-1 and DCDB-2 as shown in the schematic drawing. These loads shall be supplied from the two different buses under duplicate supply philosophy. Switchyard bay kiosks shall be fed from the two different buses alternatively and interconnected locally with auto changeover switches. Power supply to equipment operating Mechanisms shall be fed from the respective bay kiosks.

Supply of normal loads:

Normal loads shall be fed through ACDBs connected with two cables to two different sections of the 415V Main ACDB. A manual change-over switch shall be installed in each ACDB, so that the supply is not lost in case of maintenance of one section of the 415V ACDB or for a fault. These ACDB shall also supply the lighting and small single-phase loads through 240V lighting or distribution panels, located in the MCC and all over the substation. Some loads, such as switchyard lighting and air-conditioning of the control buildings, normal and fire-fighting water pumps, shall be supplied by duplicate feeders so as not to interrupt working in case of maintenance of one of the sections of the power center.

For oil treatment and welding, special service outlets shall be provided in local 415V Main ACDB or distribution boards.

2.0 LVAC supplies and equipment:**General:**

Switchboards shall be of the free standing design, suitable for mounting directly above the cable trenches laid inside the control room. Cable trench walls shall be flush with the control room floor. Switchboards shall be suitable for terminating all incoming and outgoing cables and will normally be of the bottom rear entry type, generally in accordance with IEC 947 and 439 and of metal clad design arranged for draw out isolation. Switchboards shall be equipped with circuit breakers and molded case or miniature circuit breakers. The use of fuse switches will not be permitted.

LVAC scheme:**General requirement:**

The 415V incoming supplies shall be derived from the station auxiliary transformers or in the case of a loss of supplies, from the standby diesel generator where ever applicable.

The two incoming supplies shall be interlocked to ensure that only one of the two circuit breakers can be closed at any one time. Where a bus section circuit breaker is provided it shall also be suitably interlocked to prevent the station auxiliary transformer from being back fed.

Main distribution board:

The two sections of the main distribution board shall be supplied from separate station auxiliary transformers. The two sections shall have automatic change over facilities in the event of failure of supply from one source. Each section of the board shall feed the following panels:

- Main lighting distribution board
- Firefighting pump house.
- AC and ventilation plant
- Maintenance equipment and oil treatment plant supplies.

AC distribution board:

This shall comprise two sections each of which shall be supplied through different cables from both sections of the Main Distribution Board. Each sections shall be equipped with a backup feed from the standby diesel generator set with automatic change-over facility to generator in the event of loss of supply from the main distribution board.

The AC distribution board shall supply the following loads:

- Control room supply for panels, computers, etc.
- One section of the 220V battery charger / rectifier.
- One section of the 50V battery charger / rectifier.
- 50% of switchyard bay marshalling kiosks.
- Emergency AC lighting system.
- Transformers (cooling devices and OLTC panels)
- Fire water and civic water pumps
- Spare feeders for future use.

Main lighting distribution board:

The main lighting distribution board shall receive incoming supplies from the two sections of the main distribution board as well as a supply from the diesel generator set. This board shall be further connected to lighting panels through a lighting sub-distribution panel. The panel supplying emergency lighting load and the income from the diesel generator shall be equipped to switch on in the event of failure of supply from the primary source.

3.0 Construction:

Panels:

For indoor applications the switchboards shall be of the cubicle pattern, each circuit being self-contained within its own cubicle (compartmentalized type). An access door shall be provided for each cubicle such that access can only be obtained to individual circuits. Circuits shall be segregated one from the other by earthed metal. For outdoor installation they shall be of multi-box construction.

Sheet steel for fabrication of the panels shall be 2.5 mm hot rolled sheet steel. All panel edges and cover/door edges shall be reinforced against distortion by rolling, bending or by the addition of welded reinforcement members.

Switchboard:

Switchboards shall be vermin proof and suitable for use in a tropical climate. All ventilating louvers shall be covered with a fine mesh from inside.

All switchboards shall be provided with a degree of protection of IP 52 as per IEC 947 or equivalent Indian standard. Provision shall be made in all compartments for providing IP 52 degree of protection, when circuit breaker or module trolley, has been removed.

Switchboards shall be of uniform height and shall not exceeding 2450 mm. Switchboards shall be easily extendible on both sides, by the addition of the vertical sections after removing the end covers.

All switchboards shall be divided into distinct vertical sections, each comprising:

1. A completely enclosed bus bar compartment for horizontal and vertical bus bars. Bus bar chamber shall be completely enclosed with metallic partitions. Bolted covers shall be provided for access to horizontal and vertical bus bars and all joints for repair and maintenance. Access shall be possible without disturbing feeder compartment.
2. Completely enclosed switchgear compartment(s), one for each circuit for housing circuit breaker or motor starter.
3. A compartment or alley for power and control cables. Cable alley door shall preferably be hinged. Cable alley shall have no exposed live parts, and shall have no communication with bus bar chamber.
4. A compartment for relays and other control devices associated with a circuit breaker.

All access doors shall be provided with facilities for locking in the closed position. It shall be possible to move each circuit breaker or MCCB to the disconnected position without the need to open the cubicle access door. Attempted disconnection of a circuit breaker or MCCB when in the closed position shall not result in tripping of the particular equipment.

4.0 Cubicle:

Cubicles may be arranged vertically in tiers, the number being limited only by the need to ensure that circuits are thermally independent.

It shall be possible to work within each cubicle with the equipment withdrawn whilst the incoming contacts are energized. The minimum requirements for protection shall be:

- Insulating barriers installed between phases within the cubicle.
- An insulating cover to be affixed over the protruding feeder and bus bar connections when the equipment is withdrawn.

Where this is not available, protection shall be provided by automatically operated shutters. It shall be possible to open the shutters intentionally, against spring pressure for testing purpose.

Each phase of the down dropper connections from the bus bars to the equipment isolating contacts shall be separated from the incoming or outgoing connections and from the other phases by barriers.

Cubicles shall be suitable for terminating all necessary cabling whether of copper or aluminium conductor design. It shall be possible to terminate any cable whilst adjacent circuits are energized

5.0 Bus bar and other equipment housing:

All incoming connections, bus bars and feeder connections up to the particular MCCB shall be capable of the short time current rating specified, but connections beyond the MCCB need only be matched to the MCCB characteristic.

The overall height of each tier of cubicles shall be such that the operating handles of all equipment are within the reach of a person standing at ground level. Control switches as specified shall be fitted and suitably labelled to indicate their function.

The equipment shall be complete with cable boxes and glands suitable for XLPE or PVC insulated cables.

The switchboard shall be provided with 240V single phase ac illumination and anti-condensation space heaters and each heater shall be provided with an ON/OFF switch.

Sheet steel barriers shall be provided between two adjacent vertical panels running to the full height of the switchboard, except for the horizontal bus bar compartment. Each shipping section shall have full metal sheets at both ends for transport and storage.

All equipment associated with a single circuit shall be housed in a separate compartment of the vertical section. The compartment shall be sheet steel enclosed on all sides with the withdrawable units in position or removed. The front of the compartment shall be provided with a hinged single leaf door complete with locking facilities. The main switch shall be operable from outside and will be interlocked with the compartment door such that the latter can be opened only when the switch is off.

However, it shall be possible to defeat this interlock and open and close the door with the switch ON. The main switch shall have the facility of being pad-locked in both ON and OFF positions. The switch handle shall clearly indicate the position of main switch.

After isolation of power and control circuit connections it shall be possible to safely carry out maintenance in a compartment with the bus bar and adjacent circuit live.

Necessary shrouding arrangement shall be provided for this purpose over the cable termination located in cable alley.

The temperature rise of horizontal and vertical bus bars when carrying rated current along its full run shall in no case exceed 55 0C, with silver plated joints and 40 0C with all other type of joints over an outside ambient temperature of 50 0C.

All single front switchboards shall be provided with removable bolted covers at the rear. The covers shall be provided with danger labels.

All identical circuit breakers and module chassis of same test size shall be fully interchangeable without having to carry out modifications.

All 415V switchgear cubicles shall be of single front type, with fully withdrawable circuit breakers, which can be drawn out without having to unscrew any connections. The circuit breakers shall be mounted on rollers and guides for smooth movement between **SERVICE**, **TEST** and **ISOLATED** positions and for withdrawal from the switchboard. Testing of the breaker shall be possible in the **TEST** position.

Wherever two breaker compartments are provided in the same vertical section, insulating barriers and shrouds shall be provided in the rear cable compartment to prevent accidental contact with the live parts of one circuit when working on the other circuit.

All disconnecting contacts for power circuits shall be of robust design and fully self-aligning. Fixed and moving contacts of the power draw out contact system shall be silver plated. Both fixed and moving contacts shall be replaceable.

All modules shall be fixed type except circuit breaker and motor feeder modules, which shall be draw out type.

The connections from bus bars to the main switch shall be fully insulated/shrouded, and securely bolted. The partition between the feeder compartment and cable alley may be non-metallic and shall be of such construction as to allow cable cores with lugs to be easily inserted in the feeder compartment for termination.

All equipment and components shall be neatly arranged and shall be easily accessible for operation and maintenance. The internal layout of all modules shall be subject to approval of the Project Manager.

All sheet metalwork shall be painted in accordance with the painting clause specified elsewhere in this Specification. The shade of the paint shall be 692 as per IS 5 (smoke grey).

Earthing:

It shall be possible to earth all incoming supplies to the switchboard by means of a fully rated earthing device, either by using the circuit breaker with earthing attachments, a separate earthing truck, or a fixed fully rated earth switch.

Bus bars and dead end feeders may be earthed by means of a voltage checking device and hand applied portable earth switches. These shall normally be applied from the front of the switchboard.

Earthing of current free metallic parts on the body of the switchboard shall be done with soft

drawn bare copper bus. Tail connections shall have a minimum cross sectional area of 16 mm² and the main earth bar for the switchboard shall be brought out to two terminals for connection to the station earth grid.

Earthing connections shall be carried out with green wire and the earthing studs shall be identified as such by an earthing symbol.

Clearances and insulation level:

Clearances and creepage distances in air shall be those stated in IEC 158 and 947 and be such that the equipment can withstand the dielectric tests specified.

Thermal performance of switchboard and equipment:

The complete switchboard shall be capable of carrying rated load current without the temperature rise of any portion exceeding a level of 65 °C. Parts that may be touched by operating personnel shall not exceed a level of 35 °C. In determining the load current performance of tiered cubicles it shall be assumed that all circuits are carrying rated current.

The cross sectional area of the bus bars may be graded according to the current rating, but shall remain capable of the short time current rating stated in the Schedules.

Protection co-ordination:

It shall be the responsibility of the Contractor to fully co-ordinate the overload and short circuit tripping of the circuit breakers with the upstream and downstream circuit breakers/fuses/motor starters, to provide satisfactory discrimination.

6.0 EQUIPMENT TO BE FURNISHED:

General:

The Contractor shall supply all equipment in accordance with this Specification in each of the modules as specified in the following sub clauses. Type Designation /Description of Modules:

Each 415V switchgear and distribution board shall comprise of a number of different type of modules as detailed in the following clauses. The Contractor shall obtain the approval of the Project Manager for the details of the modules to be provided in each of the Boards. The Employer has classified and type designated the modules to be used in the various Boards.

Module type	Application
AE	Electrically controlled circuit breaker for incomer and bus coupler
M1	Circuit breaker controlled motor feeder
M2	MCCB controlled motor feeder
E	
G1	VT module with under voltage relay
G2	

H and H(BC)	Isolating switch controlled incoming circuit
S	DC metering and protection module
X	
DC	Incomer from battery and charger
DG1	Electrically controlled circuit breaker for incomer from DG set
H1	
EL	
K2	Non reversible motors having star stop control at MCC

Table 4.2. 430V switchgear modules and applications

Composition of the Modules:

The following are the preferred composition of various modules along with their Bill of Materials. However the Contractor may suggest alternatives keeping in view the requirement of the specification. Such changes shall be subject to approval of the Project Manager. In addition to the items listed all other items required to provide the necessary functionality as specified in this Specification, shall be deemed to be included in the scope of supply for the module.

(A) Module type AE:

- | | | |
|-----|--|---|
| 1. | Triple pole air circuit breaker (Device No. 52)
Complete with all accessories and power operated mechanism as specified. | 1 |
| 2. | Neutral link. | 2 |
| 3. | Circuit breaker control switch with spring return to Normal. | 1 |
| 4. | Current transformer for metering. | 3 |
| 5. | Ammeter | 1 |
| 6. | Ammeter selector switch. | 3 |
| 7. | Current transformer for relaying (400/5A or 1600/5A as per station transformer rating). | 3 |
| 8. | Triple pole instantaneous over-current relay having the Setting range of 200-800% or 500-2000% of CT Secondary and adjustable definite minimum time. Alternatively suitable overcurrent releases capable Of proper discrimination with all down stream Protection are also acceptable. | 1 |
| 9. | HRC control fuse. | 8 |
| 10. | Auxiliary relays | 4 |
| 11. | Indicating lamps with series resistors and selector Lenses (eg., red, blue, green, white and amber) | 5 |
| 12. | Instantaneous earth fault relay having an adjustable setting range of 10-40% or 20-88% of CT secondary current. The earth fault relay shall be provided with a stabilising resistor. | 1 |

(B) Module type M1

1.	Triple pole air circuit breaker complete with accessories, and power operated mechanism as specified.	1
2.	Circuit breaker control switch with spring return to Normal.	1
3.	Three position 6 pole selector switch SWITCHGEAR / NORMAL / TRIAL.	1
4.	Current transformer for metering.	3
5.	Ammeter	1
6.	Ammeter selector switch.	1
7.	Current transformer for relaying.	3
8.	Triple pole instantaneous over-current relay for providing Positive sequence current protection in all the three phases. The relay setting range shall be continuously adjustable Between 200-800% or 400-1600% of CT secondary rated current as required	1
9.	Double pole inverse definite minimum time overcurrent relays connected in R and B phases for over current protection of motor rated 110 kW - 200 kW. The relay shall have an adjustable setting range of 50% - 200% of CT secondary current and time setting range of 0-30 seconds. The relay shall be CDGM-22 (GEC Alstom) or equivalent.	1
10.	Single pole adjustable definite time delay relay for Motor overload alarm connected in Y-phase only. The relay shall have resetting ratio of not less than 90%. The relay shall have continuously adjustable time delay range of 2.5 to 25 seconds.	1
11.	Instantaneous earth fault relay having an adjustable Setting range of 10-40% or 20-80% of CT secondary current. The earth fault relay shall be provided with a stabilizing resistor.	1
12.	Auxiliary relays	4
13.	Indicating lamps with resistors and coloured lenses Suitable for 220V DC.	5
14.	HRC control fuses	8

(C) Module type M2:

- 415V, 250A, P2 duty 20 kA, 50 Hz MCCB having 4 NO and 4 NC Aux. contacts. 1
- Auxiliary relays 1

- Indicating lamps with resistors and coloured lenses suitable for 240V AC. 3

Module type E:

- Triple pole load break isolating switch 1
- Neutral link 1
- HRC fuses 3

Module type G1:

1. $(415/\sqrt{3})/ (110/\sqrt{3})$ volts single phase voltage transformer star/star connected with star point solidly earthed mounted on common draw out chassis. Accuracy Class 0.5 for protection and metering with 50VA burden. 3
2. HRC Fuses mounted on the above chassis. 6
3. Four position voltmeter selector switch. 1
4. Voltmeter (0-500V) 1
5. Double pole instantaneous under voltage relays with continuous variable setting range of 40-80% of 110 Volts. 1
6. Time delay pick up relay having a time setting range of 0.5 to 3 seconds. With 3 NO self-reset contacts, Suitable for 220V DC. 1
7. Auxiliary relay 220V DC with 2 NO. Self reset contacts. 1
8. Indicating lamps with series resistor and colour lenses (Red, blue and yellow). 3

Module type G2:

1. HRC Fuse 3
2. Voltmeter (0-500V) 1
3. Voltmeter selector switch four position (R-Y, Y-B, and B-R OFF). 1
4. Indication lamps (Red, blue and yellow) 3

Module type H and H (BC)

1. Triple pole load break isolating switch with padlocking facility in OFF position and arrangement to defeat door interlocking 1
2. Neutral link. 1

3.	Red indicating lamp to indicate isolating switch closed position.	1
Module type S:		
1.	Voltmeter 0-300V DC for 220V DC DB	1
2.	Voltmeter 0-75V DC for 50V DCDB.	1
3.	Three (3) position voltmeter selector switch	1
4.	Instantaneous under voltage relay with 95% of 220V DC. The resetting ratio of relay should not be more than 1.25. The relay shall be provided with a series resistor and a push button across if for resetting (pick up) the Relay at about 105% of the drop out voltage.	1
5.	Instantaneous over voltage relay with setting range of 110% of 220V DC. The resetting ratio of relay should not be less than 0.8. The relay shall have a push button in series capable of resetting the relay at about 95% of the operating voltage	1
6.	Earth leakage relay only for 220V DC system having adjustable pick up range between 3 to 7 milliamps the relay shall be suitable for 220V DC/240V AC Auxiliary supply.	1
7.	HRC control fuses.	2
Module type X:		
1.	Double pole single throw 250V DC air break isolating switch.	1
2.	HRC fuses	2
Module type DC (Incomer from battery and chargers)		
1.	HRC fuses for incomer from battery.	2
2.	DC ammeter with shunt and range of 40-0-50 Amps. For 220V DC DB and 60-0-150 Amp for 50V DC DB.	1
3.	Double pole single throw 250V DC air break switch.	2
4.	HRC fuses for incomer from charger.	2
5.	Double pole single throw 250V DC air break switch connecting battery and charger sections to DCDB	1
Module type DG1:		
1.	Triple pole circuit breaker complete with all accessories and power operated mechanism as per the relevant sections of this Specification.	1
2.	Frequency meter.	1
3.	Voltmeter with selector switch.	1
4.	Remote/Local selector switch.	1
5.	Circuit breaker control switch with spring return to normal.	1

6.	Current transformer for metering.	3
7.	Current transformers for differential protection (out of this 3 Nos. will be supplied loose for mounting in DG set panel).	6
8.	Current transformer for relaying.	3
9.	HRC Control fuses	8
10.	Ammeter selector switch.	1
11.	Ammeter	1
12.	Wattmeter of range 0-300 kW.	1
13.	Three pole voltage controlled definite time delay relay having current setting range of 50-200% of CT secondary current and adjustable time delay 0.3 to 3 seconds.	1
14.	Watt hour meter with six (6) digits and minimum count of one (1) kWh.	1
15.	Single pole definite time over current relay having a continuous setting range of 50-200% of CT secondary current and a time delay of 2.5-25 seconds connected in CT of Y phase for overload alarm. The relay shall have a setting ratio of not less than 90%.	1
16.	Three pole differential protection relay having an operating current setting range of 10-40% of generator full load current. The relay shall be of high impedancetype, with necessary stabilising resistors.	1
17.	Indicating lamps with resistors and enclosed lenses.	5
18.	Push buttons for remote starting and stopping of diesel generator set (Red and green).	2

Module type H1:

- Double pole DC switch with pad locking facility in off Position 1

Module type EL:

- Triple pole and neutral switch 1
- HRC fuses 3
- Contactor 1
- Electronic timer suitable for continuous operation. 2
- Control Switch. 2

Module type K1:

1.	Triple pole load break isolating switch (device identifier - SW) with neutral link.	1
2.	HRC fuses (device FU) and one control fuse.	3
3.	Triple pole contactor 240V AC rated (device No. 42) with hand reset thermal overload relay (device No. 49) for thermal overload relay for more than 30 kW feeder, connection through suitable current transformers may be taken.	1
4.	Auxiliary relay (device No. 42 X) 240V AC rated with 3 NO and 3 NC self reset contacts.	1
5.	Indicating lamp 240V AC rated red coloured to give motor ON indication.	1
6.	Indication lamp 240V AC rated, green coloured to give motor OFF indication	1
7.	Push button labelled (STOP).	1
8.	Push button labelled `START'	1
9.	Switch fuse unit for space heater supply for motors rated 30 kW and above.	1
10.	Current transformer and an ammeter for all motors rated 50 kW and above.	1

Module type K2 (mounted at motor)

1.	Triple pole load break isolating switch with neutral link.	1
2.	HRC fuses and one (1) Control fuse	3
3.	Triple pole contactor rated for 240V AC	1
4.	Indicating lamp 240V AC rated red/green coloured to give ON/OFF indication.	2
5.	Push button labelled STOP	1
6.	Push button labelled START	1

Module type DG- (mounted at generator):

1.	Indicating lamps	9
2.	Push buttons	7
3.	DC Ammeter (0-40A)	1

4.	DC Voltmeter (0-30V)	1
5.	Voltmeter selector switch	1
6.	AC ammeter	1
7.	AC voltmeter	1
8.	Timers (24V DC)	3
9.	Auto/Manual selector switch	2
10.	Auto/test/Manual selector switch	2
11.	CT's for metering	3
12.	PS class CT's for differential protection of dieselgenerator set	3
13.	Auxiliary contactors suitable for 24V DC	11
14.	Motorised potentiometer for voltage adjustment	1
15.	Battery charger as per clause no Error! Reference source not found. of this section	1
16.	HRC control fuses	12
17.	Set of phase and neutral busbars.	1

Module equipment and instrumentation:

Circuit breakers, MCCB's, MCB's, selector switches, instrumentation, relays and protection equipment for LV supplies etc. shall generally conform to the requirement of the stipulated under relevant sections of this Specification.

**TECHNICAL SPECIFICATION FOR INDOOR & OUTDOOR TYPE 415/240V.
A.C POWER DISTRIBUTION SWITCH BOARDS.**

SCOPE:

The specification covers manufacture, assembly and testing at manufacturer's Works, supply and delivery at site of **Indoor and outdoor type 415/240 volts A.C. power distribution switch-boards, A.C consoles, Bay Marshalling Kiosk ,Receptacle panels** complete in all respects as per system requirement for S/S and switchyards. 20% spare feeders shall be provided in each Distribution Boards.

STANDARDS:

The equipment covered by this specification shall unless otherwise specified be built to conform to Indian Electricity Rule 2956 wherever applicable and shall satisfy the requirements of the latest Indian Standard. Permissible temperature rise shall be as per relevant ISS.

SWITCH BOARD DESIGN:

The switch board shall be self-supporting, steel cubicle, compartmentalized, fully enclosed with doors for access to the interior. The switch boards shall comprise a non / draw out type panels placed side by side to form a continuous unit with access door for each panel at the rear. Modular type construction for inter-changeability will be preferred.

3mm sheet shall be used for fabrication of the panels/kiosks/distribution boards/receptacle boards meant for outdoor installations.

3mm Aluminium sheet shall be used as canopy for all panels/kiosks/distribution boards/receptacle boards meant for outdoor installations. The canopy shall be box type instead of an aluminium sheet bolted to the distribution board of CRCA.

All indoor panels/boards/console boxes/kiosks shall be made from 2mm CRCA sheet with gland plate made of 3mm CRCA sheet.

The CT/PT console boxes may also be made of 3mm Aluminum sheet instead of 3mm CRCA sheet.

The complete panels shall not be more than 2450 mm. high with the channel base and 500 mm. depth measured from rear to front faces and of suitable width. The working height shall be limited to maximum 2200 mm. The design shall be such as to permit extension at site on either end. The bottom of the switch board frame shall be suitable for erecting flush on concrete floor by securing it by means of evenly spaced grouting bolts projecting through the base channels. The panels shall be designed to facilitate cable entry from the bottom and removable plates shall be supplied along with the panels for this purpose which will be drilled at site to fit the cable glands.

The switchboard shall be vermin proof and suitable for use in tropical climate. All ventilating louvers and holes shall be covered with fine wire mesh from inside (for indoor use). All control and power cables will be laid in open distribution trenches running under the A.C. switchboards. The cable will enter the cubicles through entry holes of removable plates provided at the bottom of the cubicles. The cable entry holes required and the position of the foundation bolts.

The switchboards shall be supplied complete with channel base, removable bottom plates grouting bolts, lock nuts, washer, etc. and cable glands as specified hereafter. All unfinished surfaces of the steel panels and frame work shall be free from adhesive matter or greases. A suitable rust resisting primer paint shall be applied on the interior and exterior surface of the steel housing allowed by application of an undercoat to serve as base and binder for the finishing coat. The finishing coat on the exterior of the switchboards shall be polished cellulose enamel or dark batter ship grey, evenly sprayed to present a fine appearance while the interior faces shall be sprayed with a finishing coat of light grey paint to provide contrasting background for the wiring inside the cubicle. The internal illumination for working should be of adequate intensity LED lamps.

A small quantity of finishing paint shall be supplied with the consignment of the Switchboards to enable the employer to restore at site any surface finish which may get damaged during transit.

BUS BARS:

The bus bars shall be of copper, liberally sized for the specific current ratings (both short circuit and continuous currents). The size of the bus bars shall be such that the current density is not more than 1.75 A per sq.mm. for copper at rated capacity. Necessary precaution shall be taken to avoid bimetallic action where copper conductors shall be connected to the aluminum bus. Means shall be provided for identifying various phases of bus bars. Bus support shall be of arc resistant, non-tracking, low absorption type insulators of high impact strength and high creepage surface. Buses shall be spaced with adequate clearance between phases and phases to ground.

The bus and connections shall be so supported as to be capable of safely withstanding stresses due to maximum short circuit current and also take care of any thermal expansion.

The droppers/riser from or to the bus bars should not be twisted but reasonable bend or joint may be allowed. The bidder shall furnish necessary calculations about the adequacy of selected bus support insulator cantilever strength w.r.t. short circuit forces.

AIR CIRCUIT BREAKER FOR INCOMER:

A.C. air circuit breaker shall be triple pole, non-draw out type, suitable for 1100 volts grade/650 volts grade service, having continuous current carrying capacity of 400 Amps with breaking capacity of 25kA. The breaker shall be provided with trip free manually operated mechanism and a push button to trip the breaker electrically.

The breaker shall be provided with mechanical OFF/ON indicators.

The breaker shall be provided with sets of auxiliary contacts for OFF/On indicating lamps, trip circuit and inter-locking circuit along with two sets of spare contacts. The door of the circuit breaker compartment shall be so interlocked that:

The ACBs should automatically switched OFF when power supply fails from station transformer and should switch ON automatically when power supply restores.

- i) The door cannot be opened whilst the breaker is in closed position (i.e. 'ON')
- ii) When the door is opened, the breaker shall be locked so that it cannot be closed (i.e. it cannot be made 'ON'). The circuit breaker shall comply with the relevant I.S.S.

The breaker shall be complete with cable glands suitable for entry of 3 x 400 sq.mm. 1100 V/650 V grade aluminum cables. One number 195 sq.mm. aluminium cable of same voltage grade as above shall be used for neutral, and cable gland suitable for entry of this cable shall also be provided in the switch board. Thermal overload relay range shall be 100 Amps to 200 Amps calibrated at 55%, 75%, 100% of the height setting and suitable time settings.

Drop out and pick up voltage of the under-voltage release shall be 60% and 80% respectively of the rated voltage.

For incoming circuit 1 no. ACB (as per requirement, it differs from sub-station to sub-station) of suitable capacity according to the system should be design and furnished provided in the panel. The details of main ACDB is as below.

1) Station Transformer capacity: 33/0.433 KV, 250 KVA. Each substation there will be two nos. station transformer, hence in Main ACDB there will be two incomer i.e., as source I and source II. There will be a bus coupler in main ACDB for extending the supply as and when required.

All outgoing feeders shall be provided with MCCB & SFU of suitable capacity according to the systems are to be provided.

INDICATING LAMPS:

Indicating lamps shall be LED type provided with suitable safety resistor, and coloured dust-tight lens. Lamps shall be of very low wattage consumption and heat generated due to continuous burning shall not deteriorate lamp cover. The lamp holders shall preferably be screwed type.

SPACE HEATERS:

The A.C. switchboards shall be provided with space heaters rated for 240 volts single phase A.C. Each heater shall be provided with ON/OFF switch. The wattage of the heater shall be such as to keep 10 OC above the ambient temperature during rainy season but the temperature shall not damage the wiring.

CABLE TERMINATION:

Switchboards shall be designed to facilitate PVC cable entry from the bottom of the switch boards. Removal plates shall be supplied for this purpose which will be drilled at site to fit the cable glands.

Sufficient space shall be provided to avoid sharp bending and for easy connection.

Cables shall be PVC insulated, armored and PVC sheathed with 2.5mm² copper conductor for control and Aluminum for cables feeder up to 15 Amp. Rating. Rest of the power cable shall be of aluminum conductor of suitable size as per feeder rating.

Multiway terminal blocks of sturdy construction complete with terminating the internal wiring and outgoing cables.

Power terminals shall be complete with lugs and control terminals shall be clamp type. Screw type terminals with screw directly impinging on conductor shall not be supplied.

Each terminal for 15 Amps. Feeders shall be capable for connection of 2 Nos. 7/0.029" copper wires at one end without any damage to the connector or any looseness of connection.

The terminal shall be properly tagged and ferruled in compliance with approved drawings. The terminal blocks shall be readily accessible and those shall be rust proof and of best quality. Terminal block connector built from cells of moulded dielectric and brass-stud inserts shall be provided. The connection stud shall project at least 6 mm. from the lock nut surface. All blocks shall be shrouded of easily removable shrouds moulded of transparent dielectric material of non-breakable type.

WIRING:

The wiring shall be complete in all respect so as to ensure proper functioning of control, protection and inter-locking schemes.

All wiring shall be complete up to the terminal blocks at the factory.

Control wiring shall be carried out with flexible, heat resistant, switchboard wires. PVC insulated with 2.5 sq.mm. stranded copper conductors. Each wire shall be identified at both ends with wire destinations numbered ferrules in accordance with bidder's wiring diagram. Wires shall not be spliced or tapped between terminal points. Each wire shall be continuous and there shall not be any joint within itself. Individual wire shall be connected only at the connection terminal, blocks, meters, relays, instruments, and other devices used in the switchboards. Red, Yellow, Blue and

Black ferrules shall be used for Red, Yellow, Blue phases and Neutral respectively.

Wires shall be neatly bunched and adequately supported so as to prevent sagging and strain on termination.

All spare contacts of the equipment shall be wired up to the terminal block. The wiring shall be of 1.1 KV grade. At least 20% spare terminals shall be provided.

Terminal shall be such that they cannot turn or be LM10 displaced when the connecting screws are tightened and such that the conductor can also not become displaced.

Terminals should be so mounted that the appropriate wire may be connected without impairing the normal performance of the unit.

SAFETY EARTHING:

Earthing of current free metallic parts of metallic bodies of the equipment on the switchboard shall be done with soft drawn bare copper bus. Tail connections shall have minimum area of 16 sq. mm. and the main earth connection for earth switchboard shall be brought out of two terminals for connection with the station earthing system.

Earthing terminals should be identified by means of the sign marked on a legible and indelible manner on or adjacent to the terminals. Earthing lugs shall be provided and all earthing connections shall be carried out with green wires.

SWITCHBOARD LIGHTING:

The switchboard illumination by providing CFL lamps and space heating arrangement to be provided.

INDICATING INSTRUMENT & ENERGY METERS:

All instruments shall be switchboard type, back connected, suitable for flush mounting. The construction shall conform, to appropriate Indian standard specifications. The instruments shall be capable of indicating freely without error when operated continuously at any ambient temperature from 0 deg. To 50 deg C. They shall withstand the effects of shock, vibration and humidity. All circuits of instruments shall be capable of withstanding 20% overload for a period of at least 8 hours. All instruments shall be provided with suitable means of adjusting the accuracy in a laboratory. KWH meters specified shall be of commercial grade accuracy. Ammeter and voltmeter shall be with accuracy of +/- 1% of full scale value.

RELAYS:

The relays shall be suitable for operation within a temperature range of 0 deg. c to 50 deg. C. The contacts of the relays shall be silvered. When open, the contacts shall withstand a voltage of 110% of the normal circuit voltage of the contacts. The relays shall not deteriorate in performance due to ageing of any constituent material. The relays shall generally comply with the requirements of I.S.S. 3842.

A.C. DISTRIBUTION BOARD SCHEME:

Power will be fed to A.C. distribution board through 2 Nos. incoming breakers separately from one no. 250 KVA station service transformer. Normally two feeders will feed power to two sections of A.C.D.B. coupled through a bus coupler breaker. Normally this coupler breaker will be kept upon when both the incomers are kept on. In case of failure of any one of the incomer, this bus-coupler will be made ON. These two incomers breakers and the bus coupler will be interlocked through castle interlock so that any two of the three breakers can be kept on at a time, Suitable scheme for electrical interlock and automatic switching on of the bus-coupler in the event of tripping of any of the healthy incomer is to be taken up by the bidder.

A 415 V single line diagram accommodating the above facilities and to suit the system is to be design and submitted to the Employer for approval. However, exact requirement layout is to be taken up by the contractor depending on the layout, rating and type of equipment for preparation of drawing.

PROTECTION SCHEME FOR INCOMING CIRCUIT BREAKER:

Each incoming circuit to the L.T. switchboard shall be protected by a Numerical relay for over current, earth fault, over voltage and under voltage protection relays. The numerical relay should be SAS compliant i.e. IEC 61850 having time synch port (IRIG-B, SNTP).

The breaker shall also be provided with under-voltage release of tripping out in case of supply failure.

CURRENT TRANSFORMERS:

The current transformer to be provided with the incoming/outgoing circuit for metering shall be air-cooled of class 'CM' accuracy. The VA burden should be such as to suit the requirements. C.Ts shall be bar primary type moulded/cast resin type. The current transformer shall be manufactured and tested according to relevant I.S.S.

INSULATION LEVEL:

The insulation at any point of the wiring in switchboards shall be suitable for 1100/660 volts grade service.

TEST – TYPE TEST REPORT shall be furnished.

DC supply equipment:

General scheme:

At 220kV substations, each DC supply system (50V and 220V DC) shall comprise duplicate batteries and battery chargers, a DC distribution board and control gear. The system shall be arranged such that only one of the station batteries and one of the battery chargers shall be in service at anyone time, but should either item of equipment fail or need to be taken out of service for maintenance, then the duplicate item of equipment can be brought into service without disruption of supplies.

Battery chargers shall be provided with an automatic change-over facility that will operate should one of the charger units fail.

At 220kV substations, each DC supply system shall be provided with one battery and one battery charger, DC distribution board and control gear for 220V DC. However the 50V DC system shall be duplicated as in case of 220kV substation.

Each battery shall be either of the Plante type (220V DC) and VRLA type(50V) and comprise a sufficient number of cells to provide the required rating. The battery charger shall be capable of float charging the battery, from the AC supply voltage specified. A facility shall be provided for boost charging individual battery cells in situ, by means of wander leads.

The batteries shall be located in a battery room and connected to the distribution boards and battery charger located in an adjacent room via a fuse box located in the battery room.

The 220V DC power supplies system will operate with both battery terminals free of earth whilst that for communications equipment (the 50V DC power supply) will operate with the positive pole permanently earthed. A suitable earth fault detection scheme shall be provided.

The battery rated output shall be that available at the outgoing terminals, after making due allowance for the resistance of inter cell connections. The battery size selected by the Contractor shall be proved by calculation which shall be subject to the approval of the Project Manager. Allowance shall be made for ageing of the battery during its service life.

Earthing of current free metallic parts on the body of the distribution boards shall be done with soft drawn bare copper bus. Tail connections shall have a minimum cross sectional area of 16 mm² and the main earth bar for the distribution shall be brought out to two terminals for connection to the station earth grid.

Earthing connections shall be carried out with green wire and the earthing studs shall be identified as such by an earthing symbol.

The distribution board shall be provided with 240V single phase ac illumination and anti-condensation space heaters and each heater shall be provided with an ON/OFF switch.

TECHNICAL SPECIFICATION FOR INDOOR TYPE 220 VOLT D.C. SYSTEM POWER DISTRIBUTION SWITCH BOARDS

SCOPE:

This specification covers manufacture, assembly and testing at manufacturer's works, supply and delivery of Indoor Type 230 volts D.C. Power Distribution on Switchboards complete in all respects as per system requirement for 220/33kV substation and switchyards. 20% spare feeders shall be provided in each DCDB. The DCDB should be SAS compliant. The voltage and load current of the DC supply shall be integrated with SAS.

STANDARDS:

The equipment covered by this specification shall unless otherwise specified, be built to conform to Indian Electricity Rules 1956 wherever applicable. Permissible temperature rise shall be as per relevant ISS.

Switchboard Design:

The switchboards shall be self supporting steel cubicle compartmentalized fully enclosed with doors for access to the interior. The switchboards shall comprise of non/draw out type panels placed side by side to form a continuous unit with access door for each panel at the rear. Modular type construction for interchangeability will be preferred. **2mm CRCA sheet shall be used for fabrication of the panels.**

The complete panels shall not be more than 2250 mm. high with me channel base and 600 mm. depth measured from rear to front faces and of suitable width. The working height shall be limited to maximum of 2000 mm.

The design shall be such as to permit extension at site on either end. The bottom of the switchboard frame shall be suitable for erecting flush on concrete floor by securing it by means of evenly spaced grouting bolts projecting through the base channels. The panels shall be designed to facilitate cable entry from the bottom and removable plants shall be supplied along with the panels for this purpose which will be drilled at site to fit the cable glands.

The switchboards shall be vermin proof and suitable for use in tropical climate. All ventilating louvers and oleos shall be covered with fine wire-mesh from inside or inbuilt type. All control and power cables will be laid in open distribution trenches running under the D.C. Switchboards. The cable will enter the cubicles through entry holes of removable plates provided at the bottom of the cubicles. The successful bidder shall furnish foundation drawings for the switchboards showing the cable entry holes required and the position of the foundation bolts.

The switchboards shall be supplied complete with channel base, removable bottom plates, grounding bolts, lock nuts, washers, etc. and cable glands as specified hereafter. All unfinished surfaces of the steel panels and frame work shall be free from adhering

matter or grease. A suitable rust resisting primer paint shall be applied on the interior and exterior surface of the steel housing followed by application of an undercoat to serve as base and binder. The finishing coat on the exterior of the switchboards shall be polished cellulose enamel, or dark battleship grey, evenly sparyed to present a fine appearance, while the interior faces shall be approved with a finishing coat of light grey paint to provide a contrasting background for the wiring inside the cubicle.

A small quantity of finishing paint shall be supplied with each consignment or the switchboards to enable the Employer to restore at site any surface finish which may get damaged during transit.

BUS BARS:

The bus bar shall be of copper, liberally sized for the specified current rating (both short circuit and continuous currents). The size of bus bars shall be such that the current density is not more than (1.75A) per sq. mm. for copper at rated capacity. Necessary precaution shall be taken to avoid bimetallic action where copper conductors shall be connected to the aluminum bus. Means shall be provided for identifying the positive and negative bus bars. Bus supports shall be of arc resistant, non-tracking, low absorption type insulators of high impact strength and high creep age surface.

The bus and connections shall be so supported as to be capable of safety withstanding stresses due to maximum short circuit current and also take care of any thermal expansion.

The droppers/risers from or to the bus bars should not be twisted but reasonable bend or joint may be allowed.

MCCB/MCB:

All incomer feeders will be provided with DC MCCB and all outgoing feeders with DC MCB conforming to latest IS: standards as per system requirements.

FUSE:

Fuses shall be HRC link type of renowned make conforming to latest issue of ISS 2208. Rewirable fuses shall not be supplied.

Fuse shall be complete with fuse bases and fittings of such design as to permit easy replacement of the fuse elements.

Link shall also be easily replaceable. Visible indication shall be provides on blowing of the fuse.

INDICATING LAMPS:

Indicating lamps shall be LED type provided with suitable safety resistor and colored dust-tight lens. Lamps shall be of very low wattage consumption and heat generated due to continuous burning shall not deteriorate lamp cover.

CABLE TERMINATION:

Switch boards shall be designed to facilitate PVC cable entry from the bottom of the switchboard. Removable places shall be supplied for this purpose which will be drilled at site to fit the cable glands.

Sufficient space shall be provided to avoid sharp bending and for easy connection.

Cables shall be PVC insulated, armored and PVC sheathed with 2.5mm² stranded copper conductor for control and for feeders upto 15 Amps. rating. Rest of the power cable shall be of aluminum conductor of suitable size as per feeder rating.

Multiway terminal blocks of sturdy construction complete with screws, nuts. Washers and marking strips shall be furnished for terminating the internal wiring and outgoing cables.

Power terminal shall be complete with lugs and control terminals shall be clamp type. Screw type terminals with screw directly impinging on conductor shall not be supplied. Connectors built from cells of moulded dielectric and brass stud inserts shall be provided for terminating the internal wiring and outgoing cables. Each terminal for 25 Amps., Feeders shall be capable for connection of 6mm² stranded copper wires at one end without any damage to the connector or any looseness of connection. The terminals shall be properly tagged and ferruled in compliance with approved drawings. The terminal blocks shall be readily accessible and those shall be rust proof and of best quality.

WIRING:

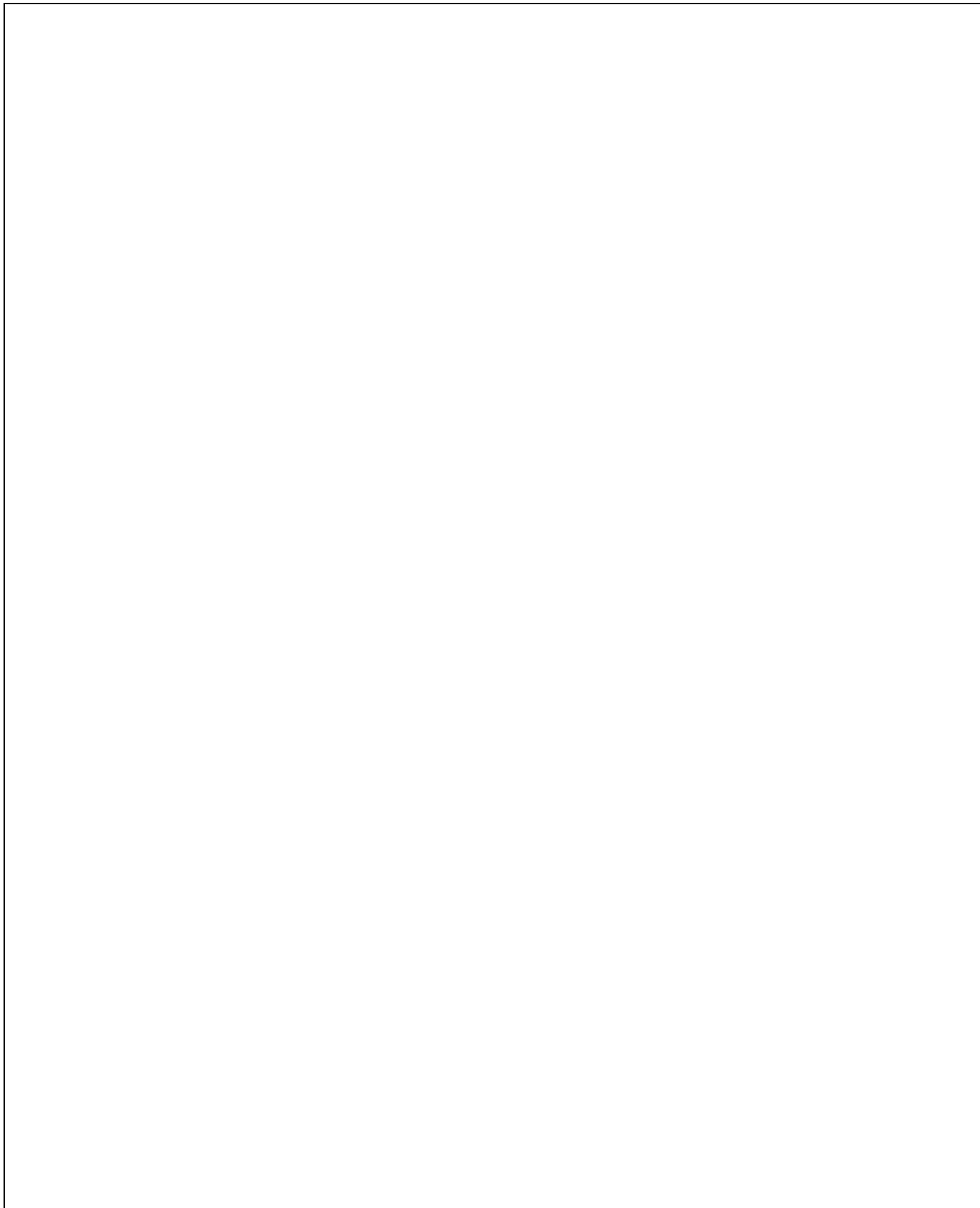
The wiring shall be complete in all respect so as to ensure proper functioning of control, protection and interlocking scheme.

All wiring shall be complete up to the terminal blocks at the factory. The insulation grade of wire to be used for internal wiring if the switch board shall be 1100 volts grade. Wiring shall be carried out with flexible heat resistant, switchboard wires PVC insulated with 2.5 sq.mm. stranded copper conductors.

Earth wire shall be identified at both ends with ferrules showing wire designations in accordance with bidder's wiring diagram. Wires shall not be spliced or tapped between terminal points.

Each wire shall be continuous and there shall not be any joint within itself. Individual wire shall be connected only at the connection terminals, blocks, meters, relays, instruments and other devices used in the switchboards. Red ferrules with positive marking shall be used for positive terminals and white ferrule with negative marking shall be used for negative terminals for D.C. wiring.

Wires shall be neatly bunched and adequately supported so as to prevent sagging and strain on termination. All spare contacts of the equipment shall be wired up to the terminal block.



SAFETY EARTHING:

Earthing of current free metallic parts of metallic bodies of the equipment on the switchboards shall be done with soft drawn bare copper bus Tail connections shall have minimum area of 26 sq. mm. and the main earth connection for each switchboards shall be brought out to two terminals for connection with the station earthing system.

Earth terminals should be identified by means of the sign marked in a legible and indelible manner on or adjacent to the terminals. Earth lugs shall be provided and all earthing connections shall be carried out with green wires.

SWITCH BOARD LIGHTING:

The interior of each panel switchboard shall be illuminated by LED lamps connected to 230 volts. Single phase A.C. supply and shall be controlled by a door-operated switch. All A.C. wiring shall be carried out with black wires. The incoming A.C. supply to the D.C. boards shall be provided with H.R.C. fuse and link of proper rating.

INDICATING INSTRUMENTS:

All instruments shall be of switchboard type, back-connected suitable for flush mounting. The construction shall conform to the appropriate Indian Standard Specifications. The instruments shall be capable of indicating freely without error when operated continuously at any ambient temperature from 0 deg. C to 50 deg. C. Those shall withstand the effects of shock, vibration and humidity. All circuits of instruments shall be capable of withstanding 20% overload for a period of at least 8 hours.

COMPLETENESS OF SUPPLY:

The switchboards offered by the bidder shall be complete in all respects. Any materials necessary which may not have been specifically mentioned but which is usual or necessary for satisfactory and trouble-free operation and maintenance of the switchboards shall be supplied without any extra charge to the employer.

SPARES:

The item wise price for the spares recommended for three years operation and maintenance of each switchboard shall be quoted.

INTER CHANGEABILITY:

All similar materials and removable parts shall be interchangeable with each other.

All switches, contactors, etc. shall be easily removable as a complete unit from the switchboards and shall be capable of being put in similar position in other switchboards for performing identical functions.

The spares called for in respective sections shall be identical with like parts provided in the main equipments in all respects and shall be capable of replacing the main equipments wherever required to carry out identical functions

ACCEPTABILITY OF DIFFERENT EQUIPMENTS & AUXILIARIES:

All equipments, cables, wires and accessories offered shall be of best quality and of renowned make for successful and trouble free operation of the switchboards.

Equipments/accessories of substandard quality shall not be accepted by the Employer.

TESTS:

The following tests are to be carried out.

- i) Checking continuity of the wiring.
- ii) Insulation resistance of all wiring circuit with all equipment mounted on the board, before and after application of H.V.
- iii) One minute power frequency voltage withstand test. All equipments and wiring shall withstand a power frequency voltage of 2kV applied between any circuit and earth.
- iv) Routine test of all equipments, switches and devices according to relevant I.S.S.
- v) Type test reports shall be furnished.

CLEARANCE:

The apparatus forming part of the panel shall have requisite clearances and these shall be maintained during normal service conditions. When arranging the apparatus within the panels, the clearances for them shall be complied with taking into account the relevant service condition. In addition, abnormal conditions such as in short circuit shall not permanently reduce the distances between bus bars.

NAME PLATE OF D.C. SWITCHBOARDS:

Each panel shall be provided with name plates, marked in a durable manner and located in a place such that they are visible and legible when the panel is installed. The following information should be given on the name plate.

- a) The manufacturer's name and /or 'trade mark' & identification number.
- b) Rated operational voltage.
- c) Purchase order number and date.
- d) Weight.

D.C. SYSTEM:

The 220 volts .D.C. supply will be available from the lead acid plante type station storage battery banks associated with battery charging equipment.

In the 220kV system the D.C. supply will be available from two sources. So the system should be designed with provision for a bus coupler.

The battery shall normally float under trickle charge conditions with the charger which continuously supplies the D.C. load to the load bus in D.C. switchboard and trickle charging current to the battery. The charger will be connected to the bus through double pole switch fuse unit. These two double pole switch unit should be mechanically interlocked so that only one switch can be closed at a time. An emergency D.C. lighting system would be provided in

each Sub-station to operate a separate lighting system with D.C. power in case of total failure of A.C. supply. The D.C. lighting system would be completely independent from the normal A.C. lighting system. For this purpose, provision shall be made in the panel for main failure contactors with contacts rated for 32 Amps. And a switch on emergency lighting circuit across the D.C. but in the vent of main failure. The two switch fuse units required for D.C. lighting feeders shall be taken from the D.C. panel Board. D.C. fail alarm both audible and visual shall be provided in case of total failure of D.C. supply at the load bus as per drawing. 220 volts D.C. system single line diagram (No.SWG/570) is enclosed in Section-8 for guidance and understanding of D.C. system. As the entire D.C. system is to be designed by the contractor depending on the rating and type of equipment being supplied, the necessary modification in the schematic diagram has to be taken up by the contractor and got approved from the Engineer.

8. BAY MARSHALLING KIOSK:

Same as ACDB but outdoor type. The purposes of these boards are to be installed in the switch yard at different locations. There shall be two incomer as source I and source II. There shall be adequate AC out lets both 3 phase with neutral and single phase, which will be taken to all the equipments and equipment marshalling boxes. **At least 20% extra outlets are to be provided besides the requirement to meet during exigencies.** All the inlet and out lets shall be provided with MCB's. The board shall have two doors one at front and the other at the rear end. Since these boards are to be installed outside in the switch yard sufficient care as per the relevant standards are to be taken care from weathering effect. At the front end all AC inlets and out lets are to be provided and at the rear end terminal blocks are to be provided in column wise for DC control /AC control purpose. The minimum quantity of terminal blocks of rating 20 Amps shall be 300 nos. with duly marked the number of terminals. At the front side also adequate capacity (current rating) as per the rating of MCB, terminal blocks to be provided for inlet and out let points of AC supply.

Proper engineering to be made and to be submitted for approval to OPTCL before manufacturing and supply. The components and wirings to be used shall be of as per IS standard and of reputed make.

9. AC CONSOLES:

Same as ACDB but outdoor type suitable for use in switchyard illumination control. Adequate nos. of MCBs for incoming and outlets are to be provided in the console to take care of the switch yard illumination system. No of such boards will be as per requirement. Care should be taken as these boards are of outdoor type. 20 % extra outlets should be provided to meet the exigencies.

10. RECEPTACLE AC SUPPLY PANEL:

Receptacle panels both indoor and outdoor types are to be provided to meet the emergency requirement of AC supply. For example welding purpose, testing purpose etc. Both three phase and single phase out lets should be provided. One no receptacle panels outdoor type shall be provided near the transformer for oil

filtration purpose. The rating of the inlet and out let MCCB, s shall be 250 Amp.

(A) DETAILS OF DISTRIBUTION BOARDS:

1) MAIN ACDB:

a) Incomer - 1: 800 Amp/1600 Amp, 25kA, draw out type, Microprocessor Control, ACB. It shall contain a numerical relay (5A rating) (IEC 61850 compliant with time synch ports: IRIG-B/ Sntp) for O/C & E/F protection with high setting provision, Under Voltage / over voltage protection. It shall also have Electrical Close/Open facility for ACB, ON/OFF lamp indication, Auto trip indication, TC healthy indication with P.B, spring charge indication, R, Y, B healthy indication.

The Incomer breaker shall trip automatically when the power supply fails and should close automatically when the power supply restores with a time lag.

The incomer breaker shall have the option to be operated through **SCADA** and Auto/Manual (Local).

The CT used for protection shall be 400/5A or 1600/5A as per the rating of the station transformer.

b) One Bus-coupler: Same as Incomer 1 above.

c) Incomer – 2: Same as Incomer – 1 above.

d) Outgoing Feeders: (For Incomer – 1)

1) 250A MCCB: 4 Nos

Or

400A-1no MCCB & 250A MCCB-3 nos. (As required)

2) 100 Amp MCCB: 4 Nos

3) Spare compartment: 2 Nos.

e) Outgoing Feeders: (For Incomer – 2) , Same as for Incomer-1 above

2) ACDB: R,Y,B Healthy Indication:

The ACDB shall have motorized MCCB for the Incomers and the DG set Incomer. The incomers shall trip automatically when the power supply fails and the DG should start automatically with a time lag.

Similarly, the DG set should stop automatically when the power supply to the ACDB is restored and the incomers shall close automatically. The DG incomer shall also have the appropriate numerical protection relay.

An Auto Manual switch should be utilized for the purpose in the Incomer panels.

Incomer -1: 400A/250A motorized MCCB and 250A motorized MCCB for DG incomer. (With interlocking facility).

Outgoing feeder(for inc. 1):

- 100A MCCB – 1 no
- 63 Amp MCCB - 15 Nos
- 32 A MCCB - 8 Nos

Bus coupler: 250 Amp MCCB

Incomer -2: 250 Amp motorized MCCB

Outgoing feeder (for Inc 2):

- 100A MCCB – 1 no
- 63 Amp MCCB - 15 Nos
- 32 A MCCB - 8 Nos

3. MAIN LIGHTING DB: R, Y, B Healthy Indication, Digital Ammeter and voltmeter with phase selector button.crc

- a. Incomer -1: 250 Amp MCCB.
- b. Outgoing feeder (for incomer 1):
 - i. 63 Amp MCCB: 4 Nos
 - ii. 32 A MCCB: 2 Nos
- c. Bus coupler: 250 Amp MCCB
- d. Incomer -2: 250 Amp MCCB
- e. Outgoing feeder (for Incomer 2):
 - i. 63 Amp MCCB: 4 Nos
 - ii. 32 A MCCB: 2 Nos

4. INDOOR RECEPTACLE DB: R, Y, B Healthy indication:

- f. Incomer: 63 Amp MCB
- g. Outgoing: 32 Amp , 3 Phase, MCB: 2
- h. Outgoing: 32 Amp , 1 Phase, MCB: 4

5. EMERGENCY LIGHTING DB:

- i. Incomer: 100 Amp MCCB
- j. Outgoing: 63 Amp ,3 Phase, MCB: 2
- k. Outgoing: 32 Amp ,1 Phase, MCB: 4
- l. Outgoing: 16 Amp ,1 Phase, MCB: 8

6. 220V DC Indoor Lighting DB:

- a. Incomer: 32 Amp DC MCB from DCDB with auto changeover facility having delay timer with auto/manual selection switch.
- b. Outgoing feeder: 16 Amp DC MCB: 5 Nos

7. 220V DCDB (SET):

220 V DC DB: 1: Having Earth fault relay (Earth leakage), under and over voltage, DC Ammeter and Voltmeter.

- a) Incomer: 100 Amp DC MCCB:
- b) Outgoing: 100 Amp DC MCCB : To couple the other DCDB
- c) Outgoing feeder: 32 Amp DC MCB: 20 Nos.

220 V DC DB: 2: Having Earth fault relay (Earth leakage), under and over voltage, DC Ammeter and Voltmeter.

- a) Incomer: 100 Amp DC MCCB:
- b) Outgoing: 100 Amp DC MCCB : To couple the other DCDB
- c) Outgoing feeder: 32 Amp DC MCB: 20 Nos.

(* 220 V DCDB-1 & 220 V DCDB-2 combined shall be treated as 220 V DCDB).

8. 48 V DCDB (SET):

50 V DC DB: 1: Having Earth fault relay (Earth leakage), under and over voltage, DC Ammeter and Voltmeter.

- a) Incomer: 100 Amp DC MCCB:
- b) Outgoing: 100 Amp DC MCCB: To couple the other DCDB
- c) Outgoing feeder: 32 Amp DC MCB: 20 Nos.

50 V DC DB: 2: Having Earth fault relay (Earth leakage), under and over voltage, DC Ammeter and Voltmeter.

- a) Incomer: 100 Amp DC MCCB:
- b) Outgoing: 100 Amp DC MCCB: To couple the other DCDB
- c) Outgoing feeder: 32 Amp DC MCB: 20 Nos.

(* 50 V DCDB-1 & 50 V DCDB-2 combined shall be treated as 50 V DCDB)

9. BMK (Suitable for Outdoor type)

- a. Incomer: 63 Amp TP MCB: 1 for source - 1 and 1 for source -2 (with timer, for auto changeover, contactors (two nos. each rated 70 Amp) suitable to take care of changeover automatically.)
- b. Outgoing feeder:
 - i. 16 Amp TP MCB : 10 Nos (front side)
 - ii. 10 Amp DP MCB: 8 Nos (front side)
 - iii. 300 nos. Terminal Block of Elmex/ any renowned make suitable for 35 Amp rated (rear side)

10. OUTDOOR RECEPTACLE DB: (Transformer filtration purpose)

- a. Near Transformer: Incomer 250 Amp MCCB: 1 No., Outgoing: 250Amp MCCB: 1 No., Having provision of R, Y, B indication. (For transformer oil filtration)

11. OUTDOOR RECEPTACLE DB: (Welding)

Inside switch yard at Different location:

Incomer: 63 Amp TPN MCB

Outgoing feeder:

- 1) 32 Amp TP MCB- 2 nos
- 2) 16 Amp DP MCB-2 nos

12. OUTDOOR KIOSK FOR SWITCHYARD LIGHTING:

A 24Hr analogue Timer shall be used for switching the lights through the use of an Auto Manual switch.

Incomer: TP MCB rating- As per the load calculation of the s/y lights

Outgoing: SP/TP MCB rating-As per the no of lights per cable route

13. OUTDOOR KIOSK FOR STREET LIGHTING:

A 24Hr analogue Timer shall be used for switching the lights through the use of an Auto Manual switch.

Incomer: TP MCB rating- As per the load calculation of the street lights

Outgoing: SP/TP MCB rating-As per the no of lights per cable route

14. OUTDOOR KIOSK FOR COLONY SUPPLY:

Near the staff quarters:

Incomer: 63 Amp TPN

MCB Out going feeder:

1) 32 Amp TP MCB- 4 nos

2) 16 Amp DP MCB-4 nos

15. OUTDOOR KIOSK FOR STATION TRANSFORMERS:

Near the Station Transformers

Incomer- 1000A isolating switch

Outgoing- 500A TPN SFU

16. 220V DC Emergency Lighting DB:

Incomer- 32A DC DP MCB

Outgoing- 16A DC DP MCB- 5
nos

The DC Emergency lights must switch on automatically when the AC supply fails and switches off when power supply is restored.

17. CT / PT Console box:

The console boxes shall be mounted on the equipment structure.

Necessary fabrication shall be done without disturbing the original members of the structure.

Disconnecting type TBs shall be fixed.

All outdoor kiosk top cover shall be of Aluminum alloy having 3mm thickness & proper sloping shall be maintained for easy drainage of water.

PART-17

TECHNICAL SPECIFICATION

- 1- COAXIAL CABLES**
- 2- CONTROL & POWER CABLES**

TECHNICAL SPECIFICATION

ITEM- H.F. CO-AXIAL CABLE, CONTROL CABLE & TELEPHONE CABLE

SCOPE:

The specification covers the design, manufacture, testing before dispatch and setting to service of the following cables for their utility in power line carrier communication system in OPTCL.

1. H.F. Co-axial cable
2. Control cable
3. Telephone cable
4. H.F. Co-axial cable

General:

- (a) The H.F.CO-axial cable shall be offered to connect the coupling unit (Line Matching under Symmetrical LMU) with PLC terminals. This serves maximum transfer of power between the carrier equipment to HT lines with minimum losses. The cable is also used for interconnection between two line matching units.
- (b) The high frequency cable to be offered shall be suitable for being laid in the ground or in trenches or in ducts. It shall be duly armoured and conform IS: 5802 of 1978.
- (c) The center core of the cable shall consist of tinned or enameled high purity copper conductor which has to be insulated by polythene sheath and shall be screened by tinned copper braidings. This braiding shall be sheathed by a PVC cover and GI wire enamoured and overall PVC sheathed and shall be suitable for tropical use. The size, type and quality of insulation shall be stated in the tender.
- (d) The capacitance of the co-axial cable shall be low as to minimize attenuation at the carrier frequency range.

Tentative Particulars:

1.	Cable impedance	125 ohm or 75 ohm unbalanced. (both shall be quoted)
2.	Centre conductor	0.8 mm dia
3.	Dia over insulation	7.6 mm
4.	Thickness of insulation	1.75 mm
5.	Outer conductor	Braiding of tinned copper (Electrolytic grade) wire of 0.2 mm dia with 90% coverage
6.	Barrier	Malinex tape
7.	Inner Sheath	Special cable grade PVC (Black/Gray) Radial Thickness – 1.2mm.
8.	Braiding & Armouring	Single braid of 0.3mm GI wire with 79% Coverage.

9.	Overall sheath	Special cable grade PVC(Black/Gray) Radial thickness- 1.4 mm
10.	Diameterover	16.0 mm (maximum)
11.	Maximum Conductor resistance	35.33 ohms/Km.
12.	Dielectric strength (Core to shield)	5 KV rms ro 1 minute.
13.	Characteristic capacitanceat 1 KHz	36.10 pf/meter
14.	Maximum attenuation at various frequencies	
	Frequency (KHz)	ds/KM
	10	0.8
	60	1.4
	300	3.30
	500	4.70
15.	Minimum bending radios for installation	20 CM
16.	Insulation resistance	Meg. Ohm/Km(Min.)

2. Telephone Cable:

1) The telephone cables are of armoured or unarmoured type depending on the requirements. The telephone cable shall have 0.5 or 0.6 mm annealed tinned copper conductor, PVC insulated, cores colour coded, twisted into pairs, laid up, and taped and overall PVC sheathed confirming to ITD specification. In case of armoured cable, it must be GI wiser/strip armoured with inner and outer sheathed confirming to IS: 1554 (Part- I)/1976.

A. The following cables may be quoted in the tender.

- a. 25 pair Armoured telephone cable
- b. 10 pair Armoured telephone cable
- c. 10 pair unarmoured telephone cable
- d. 5 pair unarmoured telephone cable.

B. The following cables may be quoted in the tender.

- a. 2.5 sq.mm twin core (solid)
- b. 10 sq.mm multistrand twin core.

C. Tests – Type Test reports shall be furnished.

TECHNICAL SPECIFICATION FOR CONTROL AND POWER CABLES

PART 1: SCOPE AND CONDITIONS

1. SCOPE:

This specification covers the testing and performance requirements of power and control cables for installation on the Distribution System to be established at the location as indicated against this tender.

The equipment offered shall have been successfully type tested and the design shall have been in satisfactory operation for a period not less than two years on the date of bid opening. Compliance shall be demonstrated by submitting with the bid, (i) authenticated copies of the type test reports and (ii) performance certificates from the users.

The power and control cables shall conform in all respects to highest standards of engineering, design, workmanship, this specification and the latest revisions of relevant standards at the time of offer and the Project Manager shall have the power to reject any work or material, which, in his judgment, is not in full accordance therewith.

2. STANDARDS:

Except where modified by this specification, the power and control cables shall be designed, manufactured and tested in accordance with the latest editions of the following standards.

IEC / ISO	Indian Standard	Title
IEC 811	IS-18-10810:1982	Testing cables
IEC 502	IS-7098:1985 (part 2)	LT and 3.3 - 33kVXLPE Cables
IEC 502	IS - 1554:1988 (part 1)	PVC Cables .65/1.IkV
IEC 227	IS - 5819:1970	Short circuit ratings for PVC cables
IEC 228	15-8130:1984	Conductors for insulated cables
IEC 502	IS - 6474: 1984	XLPE Cables
IEC 502		Extruded solid dielectric insulated power cables for rated voltages from 1kV to 30kV
IEC 540	IS - 5831: 1984	Test Methods for insulation and sheaths of electric cables and cords
IEC 287		Calculation of the continuous current rating of cables.
IS - 3975:	1979	Mildsteel wires, strips and tapes for armouring of cables

The Bidder may propose alternative standards, provided it is demonstrated that they give a degree of quality and performance equivalent to or better than the referenced standards. Acceptability of any alternative standard is at the discretion of the Project Manager. The Bidder shall furnish a copy of the alternative standard proposed along with his bid. If the alternative standard is in a language other than English, an English translation shall be submitted with the standard. In the case of conflict the order of precedence shall be 1) IEC or ISO Standards, 2) Indian Standards, 3) other alternative standards.

This list is not to be considered exhaustive and reference to a particular standard or recommendation in this Specification does not relieve the Contractor of the necessity of providing the goods complying with other relevant standards or recommendations.

3. SERVICE CONDITIONS

The service conditions shall be as follows:

- maximum altitude above sea level 11,000m
- maximum ambient air temperature 50°C
- maximum daily average ambient air temperature 35°C
- minimum ambient air temperature 0°C
- maximum temperature attainable by an object exposed to the sun 60°C
- maximum yearly weighted average ambient temperature 32°C
- maximum relative humidity 100%
- average number of thunderstorm days per annum 70%
- average number of rainy days per annum 120
- average annual rainfall 150cm
- wind pressures as per IS 802 (Part I/ Sect.I) : 1995

Wind Zones (Orissa)	2	3	5
Terrain Category 1	57.4 kg/m ²	73.1 kg/m ²	94.3kg/m ²
Terrain Category 2	49.3	62.6	80.9
Terrain Category 3	35.6	45.3	58.4
	Light	Medium	Heavy

Environmentally, the region where the work will take place includes coastal areas, subject to high relative humidity, which can give rise to condensation.

Onshore winds will frequently be salt laden. On occasions, the combination of salt and condensation may create pollution conditions for outdoor insulators.

Therefore, outdoor material and equipment shall be designed and protected for use in exposed, heavily polluted, salty, corrosive and humid coastal atmosphere.

4. SYSTEM CONDITIONS:

The equipment shall be suitable for installation in supply systems of the following characteristics:

- Frequency 50Hz
- Nominal system voltages 33kV
11KV
400/230V
- Maximum system voltages: 36.3kV
33kV System
- LV System 476V
- Minimum LV voltage 340V
- Nominal short circuit levels: 31.5kA
33kV System
- Insulation Levels:
1 .2/50 (j.s impulse
withstandvoltage

(positive and negative
polarity):33kV System 170kV
- Power frequency one minute
withstand

voltage (wet and dry) 70kV
rms 33kV System

LV System 3kV

- Neutral earthing arrangements: 33kV System solidly earthed

LV System solidly earthed

PART 2: TECHNICAL:

All power and control cables to be used in the OPTCL distribution system shall be of the cross-linked polyethylene (XLPE) or polyvinyl chloride (PVC) insulated with PVC sheathing types.

5 1.1KV POLYVINYL CHLORIDE (PVC) INSULATED CABLES:

5.1. RATED VOLTAGE AND TEMPERATURE:

The rated voltage of the cable shall be 1.1kV and the maximum operating voltage shall not exceed 110% of the rated voltage.

These cables are suitable for use where the combination of ambient temperature and temperature rise due to load results in a conductor temperature shall not exceeding 70°C* under normal operation and 160°C under short circuit conditions.

5.2. CABLE DESIGN:

All LV Power cable shall be of XLPE insulation armoured type.

The cable offered shall be single-core, four core or multi-core armoured or unarmoured XLPE insulated / PVC insulated, PVC sheathed to meet the following requirements:

5.2.1. Conductor:

- L.V System Cables (Power Cable XLPE insulated)

The conductor shall be of compacted round shape in single core cables and sector shaped in 3.5 or 4 core cables, made up from stranded aluminum wires complying with IS -8130:1984 / IEC 228. The Cable shall be of XLPE insulated with armoured.

Cables with reduced neutral conductors shall comply with the cross-sections shown in the table below.

- Control and Panel Wiring Cables (PVC insulated)

The conductor shall be of round stranded plain copper wires complying with IS - 8130:1984/IEC 228.

The conductors shall be of Flexibility Class 2 as per IS - 8130: 1984.

5.2.2. Cross-Sectional area of reduced Neutral Conductors:

Nominal cross-sectional area of main conductor (mm ²)	25	35	50	70	95	120	150	185	240	300	400	500	630
Cross-sectional area of reduced neutral conductor (mm ²)	16	16	25	35	50	70	70	95	120	150	185	240	300

5.2.3. Conductor Screening Not required.

5.2.4. Insulation:

The insulation shall be of Polyvinyl Chloride (PVC) compound. The 'General Purpose' Type A shall be used for the LV cables and 'Heat Resisting' Type C for the Control and Panel Wiring cables. Both shall conform to the requirements of IS - 5831: 1984.

Type of Insulation	Normal Continuous Operation	Short Circuit Operation
General Purpose	70°C	160°C
Heat Resisting	85°C	160°C

The PVC insulation shall be applied by extrusion and the average thickness of insulation shall not be less than the specified nominal value and the maximum value not more than 0.1mm plus 0.1 of nominal and as specified in IS - 1554(part 1): 1988. The insulation shall be applied so that it fits closely on to the conductor and it shall be possible to remove it without damage to the conductor.

5.2.5. Insulation Screening Not required

5.2.6. Core Identification and Laying Up of Cores 3.5 and 4 core cables shall be identified by colouring of the PVC insulation and multi core by numbers as per IS- 1 554 (part 1): 1988

Panel wiring shall have a single colour except for power supplies which shall be as per the above IS standard.

In multi-core cables, the cores shall be laid up together with a suitable layas recommended in IS - 1554 (Part 1): 1988. The layers shall have successive right and left hand lays with the outermost layer having a right hand lay.

5.2.7. Inner Sheath:

The laid up cores of the 3.5, 4 and multi core cables shall be covered with an inner sheath made of thermoplastic material (PVC) applied by extrusion.

The thickness of the sheath shall conform to IEC 502/IS - 1554: 1988. Single core cables shall have no inner sheath.

5.2.8. Armouring only the 3.5 and 4 core LV cables will be armoured. The armour shall be applied helically in a layer of steel wires over the inner sheath of the cable. The armour shall consist of round or flat steel wires and comply with the requirements of IEC 502/IS - 1554: 1988. The steel wires shall comply with IS - 3975:

5.2.9. Outer Sheath:

An outer sheath of polyvinyl chloride (PVC) shall be applied over the armour wires (where fitted). The sheath shall be embossed at regular intervals as per the Cable Identification clause of this specification and the minimum thickness and properties shall comply with the requirements of IEC 502/IS- 1554: 1988. The outer sheath for cables with general purpose insulation shall be of the type ST1 PVC compound and for cables with heat resisting insulation type ST2 PVC compound conforming to the requirements of IEC 502/IS - 5831: 1984.

The outer serving shall incorporate an effective anti-termite barrier and shall be capable of withstanding an 10kV DC test voltage for five minutes after installation and annually thereafter.

Cables shall be installed as a single four core cable or three single phase cables plus neutral in a close trefoil formation.

Current ratings shall be calculated in accordance with IEC 287 "Calculation of the continuous current rating of cables with 100% load factor".

5.2.10. Conductor Sizes:

- The following conductor sizes will be used on the Employer's LV distribution system: 300, 120 and 50 mm² Single core, 300 mm² three and a half core and 120 mm² four core.
- The following shall be used for Control and Panel Wiring:
2.5 mm² single core, 2. 5 and 4.0 mm² four core and 1.5 and 2.5 mm² multicore

5.2.11. Cable Drum Length:

The cable shall be supplied in 500 metre lengths.

CABLE IDENTIFICATION:

The manufacturer's and Employer's name or trade mark, the voltage grade, cable designation and year of manufacture shall be indented or embossed along the whole length of the cable. The indentation or embossing shall only done on the outer sheath. The alphanumeric character size shall be notless than 20% of the circumference of the cable and be legible.

The following code shall be used to designate cables:

Constituent	Code Letter
Aluminum conductor	A
XLPE insulation	2X
PVC insulation	Y
Steel round wire armour	W
Non-magnetic round wirearmour	Wa
Steel strip armour	F
Non-magnetic strip armour	Fa
Double steel round wire armour	WW
Double steel strip armour	FF
PVC outer sheath	Y

Note: No code letter is required for copper conductor

6 SAMPLING OF CABLES:

• **LOT:**

In any consignment the cables of the same size manufactured under essentially similar conditions of production shall be grouped together to constitute a lot.

• **Scale of Sampling:**

Samples shall be taken and tested from each lot to ascertain the conformity of the lot to specification.

• **Sampling Rates:**

The number of samples to be selected shall be as follows:

Number of drums in the Lot	Number of Drums to be taken as samples	Permissible number of defective drums
Up to 25	3	0
26 to 50	5	0
51 to 100	8	0
101 to 300	13	1
301 and above	20	1

The samples shall be taken at random. In order to achieve random selection the procedure for selection detailed in IS - 4905: 1968 shall be followed.

7 NUMBER OF TESTS AND CRITERION FOR CONFORMITY:

Suitable lengths of test samples shall be taken from each of the selected drums. These samples shall be subjected to each of the acceptance tests. A test sample shall be classed as defective if it fails any of the acceptance tests.

8 TESTS ON 1.1 kV PVC INSULATED CABLES:

8.1 Type Tests:

Certification of type tests already completed by independent test laboratories shall be presented with the bid for each cable type. These tests shall be carried out in accordance with the requirements of IS - 8130: 1984/IEC 502, IS - 5831:1984/IEC 540 and IEC 811 unless otherwise specified.

Type testing of 33kV, and 1.1 kV cables shall include the following:

Test	Requirement Reference	Test Method as a Part of IS-10810/IEC 811	
(a) Tests on conductor			
	Annealing test (copper)	IS-8130: 1984/IEC 502	1
	Tensile test (aluminium)	IS-8130: 1984/IEC 502	2
	Wrapping test (aluminium)	IS-8130: 1984/IEC 502	3
	Resistance test	IS-8130: 1984/IEC 502	5
(b) Tests for Armour wires/strips		IS - 3975: 1979/IEC 502	
	36 - 42		
(c) Tests for thickness of insulation and sheath	IS-5831:1984/IEC 5406		
(d) Physical tests for Insulation			

Tensile strength and elongation at break	IS-5831:1984/IEC 5407	
Ageing in air oven	IS-5831:1984/IEC 540	11
Hot test	IS-5831:1984/IEC 540	30
Shrinkage test	IS-5831:1984/IEC 540	12
Water absorption (gravimatic)	IS-5831:1984/IEC 540	33

(e) Physical tests for outer sheath

Tensile strength and elongation at break	IS-5831: 1984/IEC 540	7
Ageing in air oven	IS-5 831: 1984/IEC 540	11
Shrinkage test	IS-5831: 1984/IEC 540	12
Hot deformation	IS-5831: 1984/IEC 540	15

Test Requirement Reference Test Method as a Part of IS-10810/IEC811

Loss of mass in air oven	IS -5831: 1984/IEC540	10
Heat shock	IS-5831: 1984/IEC540	14
Thermal stability	IS-5831: 1984/IEC540 IS-5831: 1984 Appendix B	
(f) Partial discharge test (33kV only)		46
(g) Bending test (33kV only)		50
(h) Dielectric power factor test (33kV only)		48
As a function of voltage		
As a function of temperature		
(j) Insulation resistance (volume resistivity) test	IS-8130: 1984/IEC502	43
(k) Heating cycle test (33kV only)		49
(l) Impulse withstand test (33kV only)		47
(m) High voltage test		45
(n) Flammability test		53

Tests (g), (h), (j), (l) and (m) are only applicable to screened cables.

Notwithstanding the conditions of the above paragraph the following tests on screened 33kV cables shall be performed successively on the same test sample of completed cable.

1. Partial discharge test
2. Bending test followed by partial discharge test
3. Dielectric power factor as a function of voltage
4. Dielectric power factor as a function of temperature
5. Heating cycle test followed by dielectric power factor as a function of voltage and partial discharge tests
6. Impulse withstand test
7. High voltage test

If a sample fails in test number 7, one more sample shall be taken for this test, preceded by tests 2 and 5.

8.2 Acceptance Tests:

The following shall constitute acceptance tests:

- Tensile test (aluminium)
- Annealing test (copper)
- Wrapping test
- Conductor resistance test
- Test for thickness of insulation and sheath
- Hot set test for insulation*
- Tensile strength and elongation at break test for insulation and outersheath
- Partial discharge test (for screened cables only)**
- High voltage test
- Insulation resistance (volume resistivity) test.
- XLPE insulation only

** Test to be completed on full drum of cable

8.3 Routine Tests:

Routine tests shall be carried out on all of the cable on a particular order. These tests shall be carried out in accordance with the requirements of IS - 8130: 1984/IEC 502 and IS - 5831:1984/IEC 540 unless otherwise specified.

The following shall constitute routine tests.

- Conductor resistance test
- Partial discharge test (for 33kV screened cables only)*
- High voltage test

* Test to be completed on full drum of cable

8.4 Optional Test:

Cold impact test for outer sheath (IS - 5831 - 1984), which shall be completed at the discretion of the Project Manager and at the same time as test at low temperature for PVC as stipulated in the section on special tests.

8.5 Special tests:

Special tests shall be carried out at the Project Manager's discretion on a number of cable samples selected by the Project Manager from the contract consignment. The test shall be carried out on 10% of the production lengths of a production batch of the same cable type, but at least one production length. Special tests shall be carried out in accordance with the requirements of IEC 502 and IEC 540 unless otherwise specified.

The following special tests shall be included:

- Conductor Examination (IEC-228)
- Check of Dimensions
- 4-Hour High Voltage Test for 11 kV and 33kV Cables only
- Hot set test for XLPE Insulation
- Test at low temperature for PVC

9 DETAILS OF TESTS:

9.1 General:

Unless otherwise stated, the tests shall be carried out in accordance with the appropriate part of IS -10810/IEC 502: 1994 and the additional requirements as detailed in this specification.

9.2 Partial Discharge Test:

Partial discharge tests shall only be made on cables insulated with XLPE of rated voltages above 1.9/3.3kV.

For multicore cables, the test shall be carried out on all insulated cores, the voltage being applied between each conductor and the metallic screen.

The magnitude of the partial discharge at a test voltage equal to $1.5U_0$ shall not exceed 20pC for XLPE and 40pC for PVC, where U_0 is the power frequency voltage between the conductor and earth or J metallic screen.

9.3 Bending Test:

The diameter of the test cylinder shall be $20(d + D) \pm 5\%$ for single core cables and $15(d + D) \pm 5\%$ for multicores, where D is the overall diameter of the completed cable in millimetres and d is the diameter of the conductor. After completing the bending operations, the test samples shall be subjected to partial discharge measurements in accordance with the requirements of this specification.

9.4 Dielectric Power Factor Test:

9.4.1 Tan δ as a Function of Voltage

For cables of rated voltage 1.1 kV and above

The measured value of tan δ at U_0 shall not exceed 0.004 and the increment of tan δ between $0.5 U_0$ and $2 U_0$ shall not be more than 0.002.

9.4.2 Tan δ as a Function of Temperature For cables of rated voltage 1.1 kV and above

The measured value of tan δ shall not exceed 0.004 at ambient temperature and 0.008 at 90°C for XLPE cables.

9.5 Heating Cycle Test:

The sample which has been subjected to previous tests shall be laid out on the floor of the test room and subjected to heating cycles by passing alternating current through the conductor until the conductor reaches a steady temperature 10°C above the maximum rated temperature of the insulation in normal operation. After the third cycle the sample shall be subjected to a dielectric power factor as a function of voltage and partial discharge test.

9.6 High Voltage Test:

Type/Acceptance Test:

The cable shall withstand, without breakdown, at ambient temperature, an ac voltage equal to $3U_0$, when applied to the sample between the conductor and screen/armour (and between conductors in the case of unscreened cable). The voltage shall be gradually increased to the specified value and maintained for a period of 4 hours.

If while testing, interruption occurs during the 4 hour period the test shall be prolonged by the same extent. If the interruption period exceeds 30 minutes the test shall be repeated.

Routine Test:

Single core screened cables, shall withstand, without any failure, the test voltages given in this specification for a period of five minutes between the conductor and metallic screen.

Single core unscreened cables shall be immersed in water at room temperature for one hour and the test voltage then applied for 5 minutes between the conductor and water.

Multicore cables with individually screened cores, the test voltage shall be applied for 5 minutes between each conductor and the metallic screen or covering.

Multicore cables without individually screened cores, the test voltage shall be applied for 5 minutes in succession between each insulated conductor and all the other conductors and metallic coverings, if any.

Test Voltages:

The power frequency test voltage shall be $2.5 U_0 + 2\text{kV}$ for cables at rated voltages, up to and including 3.8/6.6kV, and $2.5 U_0$ for cables at higher rated voltages.

Values of single phase test voltage for the standard rated voltages are as given in the following table:

Voltage Grade kV	Test Voltage	
	Between conductors and screen/armour kV(rms)	Between conductors kV(rms)
0.65/1.1	3	3

If, for three core cables, the voltage test is carried out with a three phase transformer, the test voltage between the phases shall be 1.732 times the values given in the above table.

When a DC voltage is used, the applied voltage shall be 2.4 times the power frequency test voltage. In all instances no breakdown of the insulation shall occur.

9.7 Flammability Test:

The period for which the cable shall burn after the removal of the flame shall not exceed 60 seconds and the unaffected portion (uncharred) from the lower edge of the top clamp shall be at least 50mm.

10 CABLE ACCESSORIES:

The accessories are for the following types of cable:

33kV XLPE, single core round stranded plain aluminium conductor to IEC 228/IS - 8130: 1984, semi-conducting conductor screen, XLPE insulation, non - metallic semi-conducting insulation screen with non - magnetic tape or metallic cover, inner PVC sheath, non-magnetic wire or strip armour and PVC outer sheath.

LV (1100V) PVC, single, three and a half and four core round or sector shaped stranded plain aluminium grade H4 conductor, PVC insulation, inner PVC sheath, steel wire armour for three phase cables and P.V.C. outer sheath.

10.1 JOINTS AND TERMINATIONS:

Joints and terminations shall be supplied in complete kit form with all materials and components required to complete the installation. A complete set of instructions for the joint or termination shall also be included in each kit.

Heat shrink pre-moulded joints and terminations shall be required for all XLPE and PVC cables and for transition joints.

All components shall be capable of being stored without damage or deterioration at temperatures up to 50°C. The material expiry date shall be marked on all packages, where appropriate.

Details of all equipment, tools and protective clothing required to complete the joint or termination shall be included with each joint or termination kit.

Components shall not be adversely affected in any manner by contact with other materials normally used in the construction of cable joints or terminations and shall not increase the rate of corrosion of any metals with which they may come into contact.

Components supplied with adhesive coatings shall have means to prevent the coated surfaces from adhering to each other.

Joints and terminations for armoured or screened cables shall include all items needed for wire or tape clamping. Rings shall be provided for such application.

The recovered thickness of insulation over the connector shall be uniform and equal to or greater than the cable insulation thickness as given in IEC 502/IS - 1554/IS - 7098.

The protection provided by the galvanized steel wire armouring shall be reinstated over the joint (s). Electric field stress control shall be provided on all of the High Voltage joints and terminations.

Joints shall provide waterproofing, mechanical and electrical protection, and be completely sealed from cable jacket to cable jacket. Joints shall accommodate crossing of the cores.

Where required 33kV and 1.1 kV cable joints shall be straight through joints only.

Terminations shall be designed to provide a complete moisture seal, including the crotch area of multi-core cables and complete re-jacketing of the individual cores, conforming to Class 1 terminations as per IEEE 48.

They shall be generally suitable for indoor and outdoor installation, be resistant to ultra violet radiation and chemical attack.

Adhesives used shall have a softening temperature of not less than 90° C, be compatible with other components and after curing shall not flow at temperatures of normal service.

1.1 kV, and 33kV joints and terminations shall be designed so that no insulating or semi-conducting tapes shall be required. Reinstallation of the insulation and semi - conducting cover shall be achieved with the use of multiple layers of heat shrinkable tubes possessing high dielectric strength and thermal stability.

Phase identification colours shall be marked on the cable box, cable tail ends and single core cables at all connecting points and/or any positions the Project Manager may determine. Cable boxes shall be provided with suitable labels indicating the purpose of the supply where such supply is not obvious or where the Project Manager may determine.

All cables shall be identified and shall have phase colours marked at their termination.

10.2 CONNECTORS/TERMINALS:

Connectors and terminals shall perform without distress under normal loading, cyclic loading and fault conditions, and shall not limit the rating of the cables which they joint.

33kV connections shall be compressed by hydraulically operated tools and LV connectors by hand operated tools. The range of connectors/terminals should be kept to a minimum so as to limit the range of dies which may be required and the use of die-less compression tools of the tension or non-tension type shall be permitted. Only approved and proven compression tools supplied by a reputable manufacturer shall be used.

The ends of connectors/terminals shall be suitably chamfered or coned to facilitate insertion of the conductors. Connectors shall have a solid central barrier to facilitate the insertion of the conductor to the correct depth.

The following items of information shall be clearly stamped on each connector/terminal:

- Manufacturer's name or trade mark.
- The conductor size (metric) for which the connector/terminal is suitable.
- The die number or size suitable for compressing the connector/terminal.
- The part of the connector/terminal surface to be compressed.
- The sequence of die action from the starting point and finishing point.

Compounds or greases for improving contact between the connector/terminal and the conductor are permitted. They must, however, be chemically neutral to the connector/terminal and conductor materials and must be present in position in the delivered connectors/terminals. Cable connectors/terminals shall be able to accommodate typical variations in dimensions of cables supplied by different manufacturers. Connector/terminal material shall not react chemically with the cable conductors to which they are connected.

Size and type of connectors required:

Straight through connectors for the following conductors:

- 300 - 300 mm² stranded round plain aluminium
- 185-185 mm² stranded round plain aluminium
- 120-120 stranded sector shaped plain aluminium Termination lugs for the following conductors:
 - 300 mm² stranded round and sector shaped plain aluminium
 - 185 mm² stranded round plain aluminium
 - 150 mm² stranded sector shaped plain aluminium for the neutral of the 3.5 core 300 mm² cable.
 - 120 mm² stranded round and sector shaped plain aluminium
 - 70 mm² stranded round plain aluminium
 - 50 mm² stranded round plain aluminium

Termination lugs shall be suitable for bi-metallic connections.

Terminals for pole top terminations of 33kV cables shall be of the post type capable of accepting a tap off connector. Appropriate tap off connectors shall be provided for making connections from the cable to the line conductors.

10.3 CONTROL/LV WIRING ACCESSORIES

10.3.1 Terminations:

Control wire terminations shall be made with solderless crimping type and tinned copper lugs which firmly grip the conductor. Insulated sleeves shall be provided at all the wire termination. Engraved core identification plastic ferrules marked to correspond with panel wiring diagram shall be fitted at both ends of each wire. Ferrules shall fit tightly on the wire and shall not fall off when the wire is disconnected from terminal blocks. All wires directly connected to trip circuit breaker or device shall be distinguished by the addition of red coloured unlettered ferrule. Numbers 6 and 9 shall not be included for ferrules purposes except where underlined and identified as 6 and 9.

LVAC cable terminals shall be provided with adequate size crimp type lugs. The lugs shall be applied with the correct tool, which shall be regularly checked for correct calibration. Bi-metallic joints between the terminals and lugs shall be provided where necessary.

Terminals shall be marked with the phase colour in a clear and permanent manner.

A removable gland plate shall be provided by the contractor at every cable entry to mechanism boxes, cabinets and kiosks. The Contractor shall be responsible for drilling the cable gland plate to the required size.

Armoured cables shall be provided with suitable glands for terminating the cable armour and shall be provided with an earthing ring and lug in order to connect the gland to the earth bar.

PART 3: GENERAL PARTICULARS AND GUARANTEES

11 COMPLIANCE WITH SPECIFICATION:

The power and control cables shall comply in all respects with the requirements of this specification. However, any minor departure from the provisions of the specification shall be disclosed at the time of bidding in the Non Compliance Schedule in this document.

The mass and dimensions of any item of equipment shall not exceed the figures stated in the schedules.

12 COMPLIANCE WITH REGULATIONS:

All the equipment shall comply in all respects with the Indian Regulations and Acts in force.

The equipment and connections shall be designed and arranged to minimise the risk of fire and any damage which might be caused in the event of fire.

13 QUALITY ASSURANCE, INSPECTION AND TESTING

13.1 General:

To ensure that the supply and services under the scope of this Contract, whether manufactured or performed within the Contractor's works or at his sub-contractor's premises or at any other place of work are in accordance with the Specification, with the regulations and with relevant authorized international or Indian Standards, the Contractor shall adopt suitable Quality Assurance Programmes and Procedures to ensure that all activities are being controlled as necessary.

The quality assurance arrangements shall conform to the relevant requirements of ISO 9001 or ISO 9002 as appropriate.

The systems and procedures which the Contractor will use to ensure that the Plant complies with the Contract requirements shall be defined in the Contractor's Quality Plan for the Works. The Contractor shall operate systems which implement the following:

Hold Point "A stage in the material procurement or workmanship process beyond which work shall not proceed without the documented approval of designated individuals or organizations."

The Project Manager's written approval is required to authorize work to progress beyond the Hold Points indicated in approved Quality Plans.

Notification Point "A stage in material procurement or workmanship process for which advance notice of the activity is required to facilitate witness."

If the Project Manager does not attend after receiving documented notification in accordance with the agreed procedures and with the correct period of notice then work may proceed.

13.2 Quality Assurance Programme:

Unless the Contractor's Quality Assurance System has been audited and approved by the Project Manager, a Quality Assurance Programme for the Works shall be submitted to the Project Manager for approval a minimum of one month from contract award, or such other period as shall be agreed with the Project Manager. The Quality Assurance

Programme shall give a description of the Quality System for the Works and shall, unless advised otherwise, include details of the following:

- The structure of the organisation;
- The duties and responsibilities assigned to staff ensuring quality of work;
- The system for purchasing, taking delivery and verification of materials;
- The system for ensuring quality of workmanship;
- The system for control of documentation;
- The system for the retention of records;
- The arrangements for the Contractor's internal auditing;
- A list of the administration and work procedures required to achieve and verify Contract's quality requirements. These procedures shall be made readily available to the Project Manager for inspection on request.

13.3 Quality Plans:

The Contractor shall draw up for each section of the work Quality Plans which shall be submitted to the Project Manager for approval at least two weeks prior to the commencement of work on the particular section. Each Quality Plan shall set out the activities in a logical sequence and, unless advised otherwise, shall include the following:

- An outline of the proposed work and programme sequence;
- The structure of the Contractor's organisation for the Contract;
- The duties and responsibilities assigned to staff ensuring quality of work for the Contract;
- Hold and Notification Points;
- Submission of engineering documents required by the specification;
- The inspection of materials and components on receipt;
- Reference to the Contractor's Work Procedures appropriate to each activity;
- Inspection during fabrication/construction;
- Final inspection and test.

13.4 Non-conforming product:

The Project Manager shall retain responsibility for decisions regarding acceptance, modification or rejection of non-conforming items.

13.5 Sub-contractors:

The Contractor shall ensure that the Quality Assurance requirements of this specification are followed by any sub-contractors appointed by him under the Contract.

The Contractor shall assess the sub-contractor's Quality Assurance arrangements prior to his appointment to ensure compliance with the appropriate ISO 9000 standard and the specification.

Auditing of the sub-contractor's Quality Assurance arrangements shall be carried out by the Contractor and recorded in such a manner that demonstrates to the Project Manager the extent of the audits and their effectiveness.

13.6 Inspection and testing:

The Project Manager shall have free entry at all times, while work on the contract is being performed, to all parts of the manufacturer's works which concern the processing of the equipment ordered. The manufacturer shall afford the Project Manager without charge, all reasonable facilities to assure that the equipment being furnished is in accordance with this specification.

The equipment shall successfully pass all the type tests, acceptance tests and routine tests referred to in the section on Tests and those listed in the most

recent edition of the standards given in this specification.

The Project Manager reserves the right to reject an item of equipment if the test results do not comply with the values specified or with the data given in the technical data schedule.

Type tests shall be carried out at an independent testing laboratory or be witnessed by a representative of such laboratory or some other representative acceptable to the Project Manager. Routine and acceptance tests shall be carried out by the Contractor at no extra charge at the manufacturer's works.

Type Test certificates shall be submitted with the bid for evaluation. The requirement for additional type tests will be at the discretion of the Project Manager.

The Project Manager may witness routine, acceptance and type tests. In order to facilitate this, the Contractor shall give the Project Manager a minimum of four weeks' notice that the material is ready for testing. If the Project Manager does not indicate his intention to participate in the testing, the manufacturer may proceed with the tests and shall furnish the results thereof to the Project Manager.

Full details of the proposed methods of testing, including connection diagrams, shall be submitted to the Project Manager by the Contractor for approval, at least one month before testing.

All costs in connection with the testing, including any necessary re-testing, shall be borne by the Contractor, who shall provide the Project Manager with all the test facilities which the latter may require, free of charge. The Project Manager shall have the right to select the samples for test and shall also have the right to assure that the testing apparatus is correct. Measuring apparatus for routine tests shall be calibrated at the expense of the Contractor at an approved laboratory and shall be approved by the Project Manager.

The Contractor shall be responsible for the proper testing of the materials supplied by sub-contractors to the same extent as if the materials were completed or supplied by the Contractor.

Any cost incurred by the Project Manager in connection with inspection and re-testing as a result of failure of the equipment under test or damage during transport or off-loading shall be to the account of the Contractor.

The Contractor shall submit to the Project Manager five signed copies of the test certificates, giving the results of the tests as required. No materials shall be dispatched until the test certificates have been received by the Project Manager and the Contractor has been informed that they are acceptable.

The test certificates must show the actual values obtained from the tests, in the units used in this specification, and not merely confirm that the requirements have been met.

In the case of components for which specific type tests or routine tests are not given in this specification, the Contractor shall include a list of the tests normally required for these components. All materials used in the Contract shall withstand and shall be certified to have satisfactorily passed such tests.

No inspection or lack of inspection or passing by the Project Manager's Representative of equipment or materials whether supplied by the Contractor or sub-contractor, shall relieve the Contractor from his liability to complete the contract works in accordance with the contract or exonerate him from any of his guarantees.

13.7 **Guarantee:**

The Contractor shall guarantee the following:

- Quality and strength of materials used;
- Satisfactory operation during the guarantee period of one year from the date of commissioning, or 18 months from the date of acceptance of the equipment by the Project Manager following delivery, whichever is the earlier;
- Performance figures as supplied by the Bidder in the schedule of guaranteed particulars.

14 **PROGRESS REPORTING:**

The Contractor shall submit for approval within four weeks of the starting date of the contract, an outline of production, inspection, delivery (and installation) in a chart form. Within a further period of four weeks, the Contractor shall provide a detailed programme of the same information in a form to be agreed by the Project Manager. The Contractor shall submit two copies of monthly progress reports not later than the 7th day of the following month. The reports shall show clearly and accurately the position of all activities associated with the material procurement, manufacture, works tests and transport, with regard to the agreed contract programme. (The preferred format for presentation of programmes is MS Project Version 4.0. Programmes and monthly updates should be submitted on 3.5" diskettes.)

The design aspect of the progress report shall include a comprehensive statement on drawings, calculations and type test reports submitted for approval.

The position on material procurement shall give the dates and details of orders placed and indicate the delivery dates quoted by the manufacturer. If any delivery date has an adverse effect on the contract programme, the Contractor shall state the remedial action taken to ensure that delays do not occur.

The position on manufacture shall indicate the arrival of raw material and the progress of manufacture. Any events that may adversely affect completion in the manufacturer's works shall also be reported.

All works tests done shall be listed and test results shall be remarked upon. Any test failure shall be highlighted.

The dispatch of each order shall be monitored on the progress report giving the date by which the equipment will be available for transport, the estimated time of arrival on site and the dates actually achieved.

Delays or test failures in any part of the programme which may affect any milestone or final completion dates shall be detailed by the Contractor who

shall state the action taken to effect contract completion in accordance with the contract programme.

15 **SPARE PARTS AND SPECIAL TOOLS:**

The Contractor shall provide prices for spare conductor, joints and termination equipment.

The Project Manager may order all or any of the spare parts listed at the time of contract award and the spare parts so ordered shall be supplied as part of the definite works. The Project Manager may order additional spares at any time during the contract period at the rates stated in the Contract Document.

A spare parts catalogue with price list shall be provided for the various cables, joints and termination equipment and this shall form part of the drawings and literature to be supplied.

Any spare apparatus, parts or tools shall be subject to the same specification, tests and conditions as similar material supplied under the Contract. They shall be strictly interchangeable and suitable for use in place of the corresponding

parts supplied with the equipment and must be suitably marked and numbered for identification.

Spare parts shall be delivered suitably packed and treated for long periods in storage. Each pack shall be clearly and indelibly marked with its contents, including a designation number corresponding to the spare parts list in the installation and maintenance instructions.

16 PACKING AND SHIPPING:

16.1 Packing:

The cable shall be wound on strong drums or reels capable of withstanding all normal transportation and handling.

Each length of cable shall be durably sealed before shipment to prevent ingress of moisture. The drums, reels or coils shall be lagged or covered with suitable material to provide physical protection for the cable during transit and during storage and handling operations.

In the case of steel drums adequate precautions shall be taken to prevent damage being caused by direct contact between the cable sheath and the steel. These precautions shall be subject to the approval of the Project Manager.

If wooden drums are used then the wood shall be treated to prevent deterioration from attack by termites and fungi.

Each drum or reel shall carry or be marked with the following information:

- Individual serial number
- Employer's name
- Destination
- Contract Number
- Manufacturer's Name
- Year of Manufacture
- Cable Size and Type
- Length of Conductor (metres)
- Net and Gross Mass of Conductor (kg)
- All necessary slinging and stacking instructions.
- Destination;
- Contractor's name;
- Name and address of Contractor's agent in Orissa;
- Country of origin;

The direction of rolling as indicated by an arrow shall be marked on a flange.

16.2 Storage:

The site selected for the storage of cable drums shall be well drained and preferably have a concrete/firm surface which will prevent the drums sinking into the ground or being subjected to excess water thus causing flange rot.

All drums shall be stood on battens, in the upright position, and in such a manner to allow sufficient space between them for adequate air circulation. During storage the drums shall be rotated 90° every three months. In no instances shall the drums be stored "flat" on their flanges or one on top of each other.

16.3 Shipping:

The Contractor shall be responsible for the shipping of all cables, drums and reels supplied from abroad to the ports of entry and for the transport of all goods to the various specified destinations including customs clearance, offloading, warehousing and insurance.

The Contractor shall inform himself fully as to all relevant transport facilities and requirements and loading gauges and ensure that the equipment as packed for transport shall conform to these limitations. The Contractor shall also be responsible for verifying the access facilities specified.

The Contractor shall be responsible for the transportation of all loads associated with the contract works and shall take all reasonable steps to prevent any highways or bridges from being damaged by his traffic and shall select routes, choose and use vehicles and restrict and distribute loads so that the risk of damage shall be avoided. The Contractor shall immediately report to the Project Manager any claims made against the Contractor arising out of alleged damage to a highway or bridge.

All items of equipment shall be securely clamped against movement to ensure safe transit from the manufacturer's facilities to the specified destinations (work sites.)

The Contractor shall advise the storage requirements for any plant and equipment that may be delivered to the Project Manager's stores. The Contractor shall be required to accept responsibility for the advice given in so far as these arrangements may have a bearing on the behavior of the equipment in subsequent service.

16.4 Hazardous substances:

The Contractor shall submit safety data sheets in a form to be agreed for all hazardous substances used with the equipment. The Contractor shall give an assurance that there are no other substances classified as hazardous in the equipment supplied. The Contractor shall accept responsibility for the disposal of such hazardous substances, should any be found.

The Contractor shall be responsible for any injuries resulting from hazardous substances due to non-compliance with these requirements.

17 SUBMITTALS:

17.1 Submittals required with the bid:

The following shall be required in duplicate:

- completed technical data schedule;
- descriptive literature giving full technical details of equipment offered;
- type test certificates, where available, and sample routine test reports; detailed reference list of customers already using equipment offered during the last 5 years with particular emphasis on units of similar design and rating;
- details of manufacturer's quality assurance standards and programme and ISO 9000 series or equivalent national certification;
- Deviations from this specification. Only deviations approved in writing before award of contract shall be accepted;

17.2 Submittals required after contract award:

17.2.1 Programme five copies of the programme for production and testing.

17.2.2 Technical particulars:

Within 30 days of contract award five bound folders with records of the technical particulars relating to the equipment. Each folder shall contain the following information

- general description of the equipment and all components, including brochures;
- technical data schedule, with approved revisions;
- calculations to substantiate choice of electrical and mechanical component size/ratings;

- statement drawing attention to all exposed points in the equipment at which copper, aluminium or aluminium alloy parts are in contact with or in close proximity to other metals and stating clearly what protection is employed to prevent corrosion at each point;
- detailed installation and commissioning instructions;
At the final hold point for Project Manager approval prior to delivery of the equipment the following shall be submitted:
- inspection and test reports carried out in the manufacturer's works;
- Installation and maintenance instructions. 21.2.3. Operation and maintenance instructions

A copy of the detailed installation and commissioning instructions shall be supplied with each type cable joint and termination equipment.

17.3 Drawings:

Within 30 days of contract commencement the Contractor shall submit, for approval by the Project Manager, a schedule of the drawings to be produced detailing which are to be submitted for "Approval" and which are to be submitted "For Information Only". The schedule shall also provide a programme of drawing submission, for approval by the Project Manager that ensures that all drawings and calculations are submitted within the period specified above.

All detail drawings submitted for approval shall be to scale not less than 1:20. All-important dimensions shall be given and the material of which each part is to be constructed shall be indicated on the drawings. All documents and drawings shall be submitted in accordance with the provisions of this specification and shall become the property of the Employer.

All drawings and calculations submitted to the Project Manager shall be on international standard size paper, A0, A1, A2, A3, or A4. All such drawings and calculations shall be provided with a contract title block, which shall include the name of the Employer and Consultants and shall be assigned a unique project drawing number. The contract title block and project numbering system shall be agreed with the Project Manager.

Lettering sizes and thickness of lettering and lines shall be selected so that if reduced by two stages to one quarter of their size, the alphanumeric characters and lines are still perfectly legible so as to enable them to be microfilmed.

For presentation of design drawings and circuit documents IEC Publication 617 or equivalent standards for graphical symbols are to be followed.

18 APPROVAL PROCEDURE:

The Contractor shall submit all drawings, documents and type test reports for approval in sufficient time to permit modifications to be made if such are deemed necessary and re-submit them for approval without delaying the initial deliveries or completion of the contract work. The Project Manager's representative shall endeavour to return them within a period of four weeks from the date of receipt.

Three copies of all drawings shall be submitted for approval and three copies for any subsequent revision. The Project Manager reserves the right to request any further additional information that may be considered necessary in order to fully review the drawings. If the Project Manager is satisfied with the drawing, one copy will be returned to the Contractor marked with "Approved" stamp. If the Project Manager is not totally satisfied with the drawing, then "Approved Subject to Comment" status will be given to it and a comment sheet will be sent to the Contractor. If the drawing submitted does not comply with the requirements of the specification then it will be given "Not Approved" status and a comment sheet will

be sent to the Contractor. In both these cases the Contractor will have to modify the drawing, update the revision column and resubmit for final Approval. Following approval, twenty copies of the final drawings will be required by the Project Manager.

Any drawing or document submitted for information only should be indicated as such by the Contractor. Drawings and documents submitted for information only will not be returned to the Contractor unless the Project Manager considers that such drawing needs to be approved, in which case they will be returned suitably stamped with comments.

The Contractor shall be responsible for any discrepancies or errors in or omissions from the drawings, whether such drawings have been approved or not by the Project Manager. Approval given by the Project Manager to any drawing shall not relieve the Contractor from his liability to complete contract works in accordance with this specification and the condition of contract nor exonerate him from any of his guarantees.

If the Contractor needs approval of any drawing within a period of less than four weeks in order to avoid delay in the completion of supply, he shall advise the Project Manager when submitting the drawings and provide an explanation of the document's late submission. The Project Manager will endeavor to comply with the Contractors timescale, but this cannot be guaranteed.

19 SURFACE TREATMENT:

Where galvanized steel armour wire is used then the Contractor shall indicate his galvanizing process utilized and its conformance with this specification

19.1 Galvanizing:

All galvanizing shall be carried out by the hot dip process, in accordance with Specification ISO 1460 or IS 2629. However, high tensile steel nuts, bolts and spring washers shall be electro galvanized to Service Condition 4. The zinc coating shall be smooth, continuous and uniform. It shall be free from acid spots and shall not scale, blister or be removable by handling or packing. There shall be no impurities in the zinc or additives to the galvanic bath which could have a detrimental effect on the durability of the zinc coating.

Before pickling, all welding, drilling, cutting, grinding and other finishing operations must be completed and all grease, paint, varnish, oil, welding slag and other foreign matter completely removed. All protuberances which would affect the life of galvanizing shall also be removed.

The weight of zinc deposited shall be in accordance with that stated in Standard BS 729, ISO 1460 or IS 2629 and shall be not less than 0.61kg/m² with a minimum thickness of 86 microns for items of thickness more than 5mm, 0.46 kg/m² (64 microns) for items of thickness between 2mm and 5mm and 0.33 kg/m² (47 microns) for items less than 2mm thick.

Parts shall not be galvanized if their shapes are such that the pickling solution cannot be removed with certainty or if galvanizing would be unsatisfactory or if their mechanical strength would be reduced. Surfaces in contact with oil shall not be galvanized unless they are subsequently coated with an oil resistant varnish or paint.

In the event of damage to the galvanizing the method used for repair shall be subject to the approval of the Project Manager or that of his representative.

Repair of galvanizing on site will generally not be permitted.

The threads of all galvanized bolts and screwed rods shall be cleared of spelter by spinning or brushing. A die shall not be used for cleaning the threads unless specifically approved by the Project Manager. All nuts shall be galvanized. The threads of nuts shall be cleaned with a tap and the threads oiled.

Partial immersion of the work shall not be permitted and the galvanizing tank must therefore be sufficiently large to permit galvanizing to be carried out by one immersion.

After galvanizing no drilling or welding shall be performed on the galvanized parts of the equipment excepting that nuts may be threaded after galvanizing. To avoid the formation of white rust, galvanized material shall be stacked during transport and stored in such a manner as to permit adequate ventilation. Sodium dichromate treatment shall be provided to avoid formation of white rust after hot dip galvanization.

The galvanized steel shall be subjected to test as per IS-2633.

20 COMPLETENESS OF CONTRACT:

All fittings or accessories, although not specifically mentioned herein, but necessary or usual for similar equipment and their efficient performance shall be provided by the Contractor without extra charges. The bid shall clearly indicate if any additional equipment or parts would be necessary to give a complete offer and if so, the details and the prices shall be included in the bid.

MORE INFORMATION ON POWER & CONTROL CABLES [FORWORKING VOLTAGES UP TO AND INCLUDING 1100 V]

CRITERIA FOR SELECTION OF POWER & CONTROL CABLES

- 1.1 Aluminium conductor XLPE insulated armoured cables shall be used for main power supply purpose from LT Aux. Transformers to control room, between distribution boards and for supply for colony lighting from control room.
- 1.2 Aluminium conductor PVC insulated armoured power cables shall be used for various other applications in switch yard area/control room except for control/protection purposes.
- 1.3 For all control/protection/instrumentation purposes PVC insulated control cables of minimum 2.5 sq. mm. size with stranded Copper conductors shall be used.
The sizes of power cables to be used per feeder in different application shall be as applicable, described here under.
- 1.5 Bidder may offer sizes other than the sizes specified in clause 1.4. In such case and for other application where sizes of cables have not been indicated in the specification, sizing of power cables shall be done keeping in view continuous current, voltage drop & short-circuit consideration of the system. Relevant calculations shall be submitted by bidder during detailed engineering for purchaser's approval.
- 1.6. Cables shall be laid conforming to IS: 1255.
- 1.7 While preparing cable schedules for control/protection purpose following shall be ensured:
 - 1.7.1 Separate cables shall be used for AC & DC.
 - 1.7.2 Separate cables shall be used for DC1 & DC2.
- 1.8 For different cores of CT & CVT separate cable, core wise shall be used .The minimum sizes of the conductor for each terminal shall be 2X2.5sqmm.
- 1.9 For control cabling, including protection circuits, minimum 2.5 sq.mm.size copper cables shall be used per connection.

TECHNICAL REQUIREMENTS:

2. General:

- 2.1 The cables shall be suitable for laying in racks, ducts, trenches, conduits and underground buried installation with uncontrolled back fill and chances of flooding by water.
- 2.2 They shall be designed to withstand all mechanical, electrical and thermal stresses under steady state and transient operating conditions.
- 2.3 The XLPE insulated cables shall be capable of withstanding a conductor temperature of 250°C during a short circuit without any damage. The PVC insulated cables shall be capable of withstanding a conductor temperature of 160°C during a short circuit.

- 2.4 The Aluminium/Copper wires used for manufacturing the cables shall be true circular in shape before stranding and shall be uniformly good quality, free from defects. All Aluminium used in the cables for conductors shall be of H2 grade. In case of single core cables armours shall be of H4 grade Aluminium.
- 2.5 The fillers and inner sheath shall be of non-hygroscopic, fire retardant material, shall be softer than insulation and outer sheath shall be suitable for the operating temperature of the cable.
- 2.6 Progressive sequential marking of the length of cable in metres at every one meter shall be provided on the outer sheath of all cables.
- 2.7 Strip wire armouring method (a) mentioned in Table 5, Page-6 of IS: 1554 (Part 1) – 1988 shall not be accepted for any of the cables. For control cables only round wire armouring shall be used.
- 2.8 The cables shall have outer sheath of a material with an oxygen index of not less than 29 and a temperature index of not less than 250°C.
- 2.9 All the cables shall pass fire resistance test as per IS:1554 (Part-I)
- 2.10 The normal current rating of all PVC insulated cables shall be as per IS: 3961.
- 2.11 Repaired cables shall not be accepted.

3. XLPE Power Cables:

- 3.1 The XLPE (90°C) insulated cables shall be of FR type, C1 category conforming to IS: 7098 (Part-I) and its amendments read along with this specification. The conductor shall be stranded aluminium circular/sector shaped and compacted. In multicore cables, the core shall be identified by red, yellow, blue and black coloured strips or colouring of insulation. A distinct inner sheath shall be provided in all multicore cables. For XLPE cables, the inner sheath shall be of extruded PVC of type ST-2 of IS: 5831. When armouring is specified for single core cables, the same shall consist of aluminium wires/strips. The outer sheath shall be extruded PVC of Type ST-2 of IS: 5831 for all XLPE cables.

4. PVC Power Cables:

- 4.1. The PVC (70°C) insulated power cables shall be of FR type, C1 category, conforming to IS: 1554 (Part-I) and its amendments read along with this specification and shall be suitable for a steady conductor temperature of 70°C. The conductor shall be stranded aluminium. The Insulation shall be extruded PVC to type-A of IS: 5831. A distinct inner sheath shall be provided in all multicore cables. For multicore armoured cables, the inner sheath shall be of extruded PVC. The outer sheath shall be extruded PVC to Type ST-1 of IS: 5831 for all cables.

5. PVC Control Cables:

5.1 The PVC (70°C) insulated control cables shall be of FR type C1 category conforming to IS: 1554 (Part-1) and its amendments, read along with this specification. The conductor shall be stranded copper. The insulation shall be extruded PVC to type A of IS: 5831. A distinct inner sheath shall be provided in all cables whether armoured or not. The over sheath shall be extruded PVC to type ST-1 of IS: 5831 and shall be grey in colour.

6. HV POWER CABLES [FOR WORKING VOLTAGES FROM 3.3 kV AND INCLUDING 33 kV]

6.1. HV POWER CABLE FOR AUXILIARY POWER SUPPLY:

The HV cable of voltage class as specified for LT transformer shall be, XLPE insulated, armoured cable conforming to IS 7098 (Part-II) or IEC 60502-2 1998. Terminating accessories shall conform to IS 17573-1992 or IEC 61442/1997/IEC60502-4 1998.

6.2. Constructional Requirements:

Cable shall have compacted circular Aluminium conductor, Conductor screened with extruded semi conducting compound, XLPE insulated, insulation screened with extruded semi conducting compound, armoured with non-magnetic material, followed by extruded PVC outer sheath (Type ST-2), with FR properties.

6.3 Progressive sequential marking of the length of cable in metres at every one metre shall be provided on the outer sheath of the cable.

6.4 The cables shall have outer sheath of a material with an Oxygen Index of not less than 29 and a Temperature index of not less than 250°C.

7. TYPE TESTS:

7.1 All cables shall conform to all type, routine and acceptance tests listed in the relevant IS.

THE SIZES OF POWER CABLES TO BE USED PER FEEDER IN DIFFERENT APPLICATION SHALL BE AS APPLICABLE, DESCRIBED HERE UNDER.

S.No.	From	To	Cable size	Cable type
1.	Main Board Switch	LT Transformer	2-1C X 630 mm ² per phase 1-1CX 630 mm ² for neutral	XLPE
2.	Main Board Switch	AC Distribution Board	2-3½C X 300 mm ²	XLPE
3.	Main Board Switch	Oil Filtration Unit	1-3½C X 300 mm ²	XLPE
4.	Main Board Switch	Colony Lighting	1-3½C X 300 mm ²	XLPE
5.	Main Board Switch	HVW pump LCP	1-3½C X 300 mm ²	XLPE
6.	Main Board Switch	Main Lighting distribution board	1-3½C X 300 mm ²	XLPE
7.	AC Distribution Board	D.G. Set AMF Panel	2-3½C X 300 mm ²	PVC
8.	AC Distribution Board	Emergency Lighting distribution board	1-3½C X 70 mm ²	PVC
9.	AC Distribution Board	ICT MB	1-3½C X 70 mm ²	PVC
10.	AC Distribution Board	Bay MB	1-3½C X 70 mm ²	PVC
11.	Bay MB	AC Kiosk	1- 3 ½ x 35 mm ²	PVC
12.	AC Distribution Board	Battery Charger	1-3½C X 70 mm ²	PVC
13.	DCDB	Battery	2-1C X 150 mm ²	PVC
14.	DCDB	Battery Charger	2-1C X 150 mm ²	PVC
15.	DCDB	Protection/PLCC panel	1-4C X 16 mm ²	PVC
16.	Main Lighting DB	Lighting panels(Indoor)	1-3½C X 35 mm ²	PVC
17.	Main Lighting DB	Lighting panels (outdoor)	1-3½C X 70 mm ²	PVC
18.	Main Lighting DB	Receptacles (Indoor)	1-3½C X 35 mm ²	PVC
19.	Main Lighting DB	Receptacles(Outdoor)	1-3½C X 70 mm ²	PVC
20.	Lighting Panel	Sub lighting	1-4C X 16 mm ²	PVC
21.	Lighting Panel	Street Lighting Poles	1-4C X 16 mm ²	PVC
22.	Lighting Panel/ Sub lighting panels	Lighting Fixtures (Outdoor)	1-2C X 6 mm ²	PVC

PART 4: SCHEDULES

21. TECHNICAL DATA SCHEDULES

3. 1100V Cable Schedule

- Remarks:-**
- All the LV Power Cable shall be XLPE with insulated armoured Aluminum Cable.
 - All the Control Cable shall be PVC insulated Cables.

PART-18
AIR CONDITIONING SYSTEM

TECHNICAL SPECIFICATION FOR AIR CONDITIONING SYSTEM

1.0 SCOPE:

This Specification covers Supply, Installation, Testing and Commissioning and Handing over of Air Conditioning System and Ventilation system for the Control Room Building.

Air conditioning units for control room building shall be set to maintain the inside DBT at 24.4 Deg C \pm 2 Deg C.

The following room shall be air conditioned

- a) Control Room
- b) Conference room
- c) Testing lab

Air conditioning requirement of rooms indicated shall be met by using split AC units. High wall type split AC units of required capacity as per design (to be submitted for approval) with high wall type indoor evaporator unit shall be used. In case the area is more than ductable split AC units may also be designed for better effect.

The exact quantity of the split AC units shall be designed taking the room area and the same may be proposed for necessary approval. However 2 TR capacity split AC units of 5 star rating to be considered. The quantity shall be approximately as mentioned below.

PROPOSED NO OF A.C UNITS:

INVERTER TYPE WITH COPPER CONDENSER

1) FOR ALL 220//33 KV S/S CONTROL ROOM AREA

A) 220/33 KV S/S:As per BoQ and cooling calculations..

- Copper refrigerant piping complete with insulation between the indoor and remote outdoor condensers as required.
- SCOPE: The scope of the equipment to be furnished and services to be provided under the contract are outlined herein and the same is to be read in conjunction with the provision contained. The scope shall be deemed to include all such items which although not specifically mentioned in the bid documents and/or in bidders proposal, but are required to make the equipment/system complete for its safe, efficient, reliable and trouble free operation.
- Unit should be hermetically sealed
- PVC drains piping from the indoor units up to the nearest drain point to be done.
- Power and control cables between the indoor unit and outdoor unit and earthing
- GI brackets for outdoor condensing unit and proper earthing.
- Specification for Split AC units:

The split AC units will be complete with indoor evaporator unit, outdoor condensing units and cordless remote control units.

Outdoor units shall comprise of hermetically sealed rotary compressors mounted on vibration isolators, propeller type axial flow fans and copper tube aluminium finned coils assembled in a sheet metal. The casing and the total unit shall be properly treated and shall be weather proof type. They shall be compact in size and shall have horizontal discharge of air.

The indoor unit shall be high wall type. The indoor unit shall be compact and shall have elegant appearance. They shall have low noise centrifugal blowers driven by special

motors and copper tube aluminium finned cooling coils. Removable and washable polypropylene filters shall be provided. They shall be complete with multifunction cordless remote control unit with special features like programmable timer, sleep mode and softy dry mode etc.

The split AC units shall be of Carrier / Blue Star / Hitachi / Voltas / Samsung / LG make.

2. PROVISION OF AIR-CONDITIONING SYSTEM IN THE SWITCHYARD KIOSK OR ANY UNMANNED STATION AS SPECIFICALLY ASKED FOR:

The descriptions of the units are as indicated below:

The Air Conditioning system with voltage stabilizer, which shall be provided in the Building/kiosk. These Building/kiosk shall be generally unmanned; therefore, the air-conditioning system shall be rugged, reliable, maintenance free and designed for long life. The air conditioning is required for critical application i.e. for maintaining the temperature for critical sub-station GIS/AIS equipment, control and protection equipment. To provide redundancy for such critical applications, the building shall be installed with environment control system comprising of the units of air conditioners working in conjunction through a micro-processor based controller for desired operation. The system shall be designed for 24 Hours, 365 Days of the year to maintain the inside the building/kiosk temperature to a suitable temperature (23 +2 deg C) or as decided. The required nos. of the air conditioners shall be running at a time and the failure of any one unit or as described here under the standby/other unit shall automatically run to ensure longer life of the air conditioning system. The redundant unit shall also be running in cycle operation (for a cycle time of 4 hours /12 hours user defined) through the controller. However during running of the air conditioner unit if the inside temperature of the building reaches to a pre-defined (30 deg C) the other shall start running to maintain the temperature to a specified value (23 +2 deg C). After achieving this temperature the standby/other unit shall again shut off.

Capacity: Main Unit having dual compressor minimum of 2TR each & Stand by Unit having dual compressor minimum of 2TR each.

Compressor Type: Scroll

Power supply: 230 V, 50 Hz

Controller: Microprocessor control & should have provision of monitoring the temperature from the Main control room with integration facility to SAS. Control boxes etc for completing the A.C scheme.

PART-19
FIBRE OPTIC TERMINAL EQUIPMENT

TECHNICAL SPECIFICATION

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1. OPTIC FIBRE EQUIPMENT AND NETWORK CONFIGURATION

1.1 Introduction:

This section describes the Fibre Optic Communication network configuration and the equipment characteristics for communication system to be installed under the project. The sub-systems addressed within this section are:

- (1) Fibre Optic Transmission System (FOTS) Termination
- (2) Termination Equipment Subsystems
- (3) Network Management System
- (4) (NMS) MDF, DDF and Cabling

Network Management System (NMS) for monitoring and control of this communication network. TMN and NMS have been interchangeably used in this specification.

1.2 General Network Characteristics:

1.2.1 Description:

The proposed fibre optic communication network shall support the voice & data communication requirements of RTUs and the SCADA/EMS system. The communication system shall provide data & voice connectivity across the various locations or connectivity of RTUs with Control Centers. The RTUs located at various locations will report to Control Center using IEC 60870-5-101 or IEC 60870-5-104 Protocol. The proposed communication system shall provide connectivity of some RTUs over TCP/IP protocol using Ethernet interface and other RTUs over serial interface. The fibre optic network shall be based on Synchronous Digital Hierarchy (SDH) i.e. STM-4. However, the offered equipment can be upgraded to STM- 16 by changing the optical card only. The Contractor can propose a system based on higher bit rate systems, if required, so as to meet the link budget requirements or any other specification requirement.

1.2.2 Functional Requirement:

The primary function of the communication network is to provide a highly reliable voice and data communication system in support of the SCADA/EMS. The communications support requirement for SCADA/EMS system is for low & high speed data, express voice circuits and administrative voice circuits as defined in appendices. A brief summary of the communication system requirements is as follows:

- High speed E1 channel support
- 64kbps & nx64kbps data channel support
- Low speed (300 -1200 bps) data channel support
- Voice (2 wires, 4 wires) channel support.
- Data transport supporting Network Management channels

The connectivity envisaged between RTUs and Control Centre is Wide Area Network (WAN) on TCP-IP using IEC 60870-5-104 protocol and IEC 60870- 5-101 protocol.

1.2.3 General Systems Requirements:

Required characteristics are defined and specified herein at the system level, subsystem level, and equipment level.

1.2.3.1 System Synchronization:

The Contractor shall synchronize all the equipment under the contract using Master Clock (PRC). The Contractor shall provide the GPS based clock. In addition to GPS input reference, the synchronization clock must have provision to take INPUT reference coming from other clock. The contractor shall submit the synchronization plan as per standard ITU-T G.811. All sync equipment proposed under this contract should meet ITU-T G.811 criterion. The holdover quality of clock shall meet ITU-T G.812 standard requirements. The Contractor shall provide system wide synchronization fully distributed throughout the telecom network and connected to all equipment. The Contractor shall submit the synchronization plan for the entire network meeting the requirement of ITU-T G.803.

The system equipment requiring “clock” shall be connected to the master clock using external clocking. For this purpose, appropriate interfaces(s) in the transmission & termination equipment being supplied and all other associated hardware shall be provided by the Contractor.

1.2.3.2 System Maintainability:

To facilitate performance trending, efficient diagnosis and corrective resolution, the system shall permit in-service diagnostic testing to be executed both locally and from remote locations, manually and/or initiated under TMN control. Such testing shall not affect the functional operation of the system.

Preventive and problem oriented maintenance of the communications system shall be performed using diagnostics tools such as TMN and test

equipment. They shall support complete maintenance of all system elements and shall permit the diagnosis of any fault without requiring additional test equipment. The Contractor shall provide specialized training required to operate above mentioned diagnostic tools. For all redundant systems, disconnection and repair of any failed device shall not interrupt the operation of the system.

1.2.3.3 System Upgradeability and Expandability:

Equipment supplied shall be sized (though not necessarily equipped) to support system/ subsystem expansion to full capacity as provided by specified aggregate transmission rates. Equipment units provisioned for equipped subunits shall be terminated at appropriate patching facilities or termination blocks. Power supplies and TMN shall be sized for maximum equipped system capacity.

1.2.3.4 Equipment Availability:

The availability requirements are as follows, which shall be demonstrated at site for the equipment being provided under this contract:

- The availability of each fibre optic link (E1 to E1) shall be at least 99.999%.
- The availability of network end to end (E1 to E1) shall be at least 99.998%.
- The average per link subscriber to subscriber availability shall be at least 99.97%. The per link subscriber to subscriber availability is defined as the availability between any two data or voice subscribers between RTU to reporting Control Centre.
- The network-wide subscriber to subscriber availability shall be at least 99.8%. The network-wide subscriber to subscriber availability is defined as the availability between any two data or voice subscribers on the wideband network.

The calculated availability is defined as the theoretical availability determined by a statistical calculation based on the mean-time-between-failure (MTBF) and the mean-time-to-repair (MTTR) of the components and subsystems comprising the FOTS. The down time of the fibre optic cable shall not be considered in the aforesaid availability calculations.

In order to ensure that the equipment & configuration proposed by the bidders shall be capable of demonstrating the specified availability figures it is required that the Bidders shall include in their proposal a calculated availability analysis for the proposed equipment/ sub system. The calculated failure rates of the units and the calculated availabilities of the equipment being offered shall be provided in the proposal. The analysis shall be based on an availability block diagram

and shall include the mean-time- between failure (MTBF) and mean-time-to-repair (MTTR) of all of the components on the link. The Contractor shall indicate in the analysis the MTBF and MTTR and the resulting availability of each point-to-point link. For this analysis, an MTTR of at least 4 hours shall be assumed.

1.2.4 General Equipment Characteristics:

All Contractor supplied equipment shall be new and of the finest production quality. OPTCL will not accept modules or printed-circuit boards that are modified by appending wires or components. Wired strapping options shall be incorporated in the board design to meet the above requirement.

All applicable requirements stated in this section shall equally apply to the TMN equipment as specified in this Section.

1.2.4.1 Revision Levels and Modifications:

All hardware, firmware and software delivered as part of the communications network shall be field proven and at the most of current revision level. All modifications and changes necessary to meet this requirement shall be completed prior to the start of the factory tests or under special circumstances, on written approval by OPTCL, prior to the completion of SAT.

All field modifications of the hardware, firmware and software that is required to meet installation and/or performance specifications, shall be fully documented as part of the deliverables, both as a separate field modifications record and as corrected equipment/configuration documentation.

1.2.4.2 Equipment Capacities:

Equipment supplied shall be sized and equipped with sufficient capacity to support BOQ and configuration. Each subsystem supplied shall be sized (to be equipped as specified) to support full subsystem expansion.

Data communications channelization required to support the TMN subsystems specified in Technical Specifications (TS) are not identified in the appendices. Therefore, the Contractor is required to size and equip the system to include all channelization and channel cards required to support the TMN function.

1.2.4.3 Redundancy Requirements and Protection Schemes:

Equipment redundancy and Automatic Protection Schemes (APS) are specified in the Table 1.1. The failure of one element shall not prevent the use of any other that has not failed.

Table 1.1

Equipment Redundancy Requirements Summary

Fiber Optic transmission Equipment:	
SDH equipment	
Power Supply & Converters -----	1:1 APS or distributed power supply
Common Control* Cards -----	1:1 APS
DACS (Cross Connect)	
Power Supply -----	1:1 APS or distributed power supply
Common control* cards-----	1:1 APS
MUX, DROP/INSERT	
Power Supply -----	1:1 APS or distributed power supply
* = Common control cards which are essentially required for operation of the equipment.	

The offered equipment shall support at least SNCP **as per standard ITU-T G.841**. In case the equipment offered by the Bidder does not support the above mentioned minimum protection methods, the bidder shall have to provide all additional equipment needed to provide same level of flexibility, redundancy and functionality at no additional cost to OPTCL. The bidders shall provide details of protection schemes supported in the Bid document.

The offered equipment shall support automatic switchover function between the redundant modules and all required modules and hardware to support the automatic switch over shall be provided by the Contractor.

1.2.4.4 Lost Signal Recovery:

At any digital signal level, reapplication of a lost signal shall result in automatic resynchronization and full restoration to normal operation without manual intervention. All alarms incident to the signal failure, shall be automatically cleared at the equipment, rack and monitoring levels and normal operation indications restored and reported if applicable.

1.2.4.5 Equipment Lifespan:

All equipment supplied shall have a minimum expected life of fifteen (15) years. From the date of operational acceptance.

1.2.4.6 General Site Considerations:

All fiber optic links up to 250kms transmission line route length shall be implemented by the Contractor without repeaters. In order to meet the link budget requirement, the Contractor shall provide all the necessary equipment only in the end stations. The contractor may provide the optical amplifier, wave length translator, optical cards or high capacity SDH equipment with suitable rack/sub-rack to meet the maximum distance limit. All the provided equipment shall be monitored by centralized NMS which is already in operation at SLDC.

1.2.5 Fibre Optic Link Lengths:

The lengths specified in appendices are the transmission line route lengths; however the actual fiber cable length shall exceed the route lengths on account of extra cable requirement due to upcoming LILO sub-stations, sag, jointing & splicing, approach cabling etc. For bidding purposes the Contractor may assume an additional cable length of 5% of given route length + 1Km towards approach cable for calculating the link length. The exact cable lengths shall be determined by the Fibre

Optic cable package Contractor during the survey. The same shall be forwarded to this package Contractor for final link design during the detailed engineering of the project. In case of change in the specified BOQ, the contract price shall be adjusted accordingly.

1.3 Fibre Optic Transmission System:

The Fibre Optic Transmission System (FOTS) is defined herein to include ETSI digital optical line termination equipment. The FOTS shall be based on SDH technology. Minimum aggregate bit rate shall be STM-4 and equipped with minimum 2 nos. of 16 port E1 interface (G.703) card & one no. Of minimum 4 port Ethernet interface (IEEE 802.3/IEEE 802.3u) card supporting layer 2 switching as tributaries. The Ethernet interfaces shall support VLAN (IEEE 802.1P/Q), spanning tree (IEEE 802.1D) quality of service. The Contractor shall provide (supply and install) connectorised jumpers (patch cords) for FODP-to-equipment and equipment-to-equipment connection. Two number spare jumpers shall be provided for each equipment connection. Fiber jumpers shall be of sufficient lengths as to provide at least 0.5m of service loop when connected for their intended purpose.

1.3.1 SDH Equipment:

1.3.1.1 Functional Requirement:

For the purpose of BOQ, the SDH Equipment is considered to be divided in three parts i.e. Optical cards (Line), Tributary Cards (Electrical tributaries such as E1 & Ethernet 10/100 Mbps) and Base Equipment (Consisting of Common Cards, Power supply cards, sub-rack, cabinet, other hardware and accessories required for installation of equipment i.e. Everything besides optical cards and tributary cards). The offered SDH equipment shall be upgradeable to STM-16 by changing optical line cards only. Cross connection (VC4) capability of offered SDH equipment shall be provided according to STM-4 equipment. The contractor shall demonstrate the STM 4 to STM 16 upgradeability during FAT.

SDH ADM:

The aggregate interfaces shall be (at least) STM-4 (622 Mbit/s) towards at least 3 directions (Protected as specified in this specifications). At present the equipment shall be equipped with a 2 nos., min.16 E-1 port electrical tributary cards & one no., min.4 port Ethernet interface card as tributaries. The Equipment shall provide access to full STM4 payload.

1.3.1.2 Redundancy and Protection:

Two fibre rings shall be implemented wherever the network permits. On linear sections of the network, protected links using 4 fibres shall be

implemented.

1.3.1.3 Service Channel:

Service channels shall be provided as a function of the SDH equipment and shall be equipped with Service Channel that shall provide at a minimum: One voice channel (order wire) with analog interface (0.3 to 3.4 kHz) and one data channel. Both omnibus and selective calling facilities shall be provided. There shall be a facility to extend the line system order-wire to any other system or exchange lines on 2W/4W basis.

1.3.1.4 Supervision and Alarms:

ISM (In Service Monitoring) circuitry shall be provided as a function of the SDH equipment. Local visual alarm indicators shall be provided on the equipment, as a rack summary alarm panel. Alarms shall be as per ITU-T Standards G.774, G.783 and G.784. Additionally, F2/Q2 interfaces for a local craftsperson terminal interface and remote equipment monitoring is required.

The Equipment shall support collection of at least four (4) external alarms for monitoring and control of station associated devices by the TMN.

1.3.1.5 Synchronization:

The equipment shall provide synchronization as per Table 1-2. One 2MHz synchronization output from each equipment shall be provided.

1.3.1.6 Electrical and Optical I/O Characteristics and General Parameters:

Table 1.2 provides the electrical and optical characteristics as well as other general parameters for SDH equipment.

Table 1.2
Electrical and Optical I/O Characteristics and General Parameters

Optical Wavelength NOTE (1)	1310/1550nm
Optical Source NOTE (2)	Laser
Optical Source Lifespan	Better than 5 X10 ⁵ hours
Optical Fibre Type	G.652 D
Optical Connectors	Type FC-PC
Transmission Quality	Per ITU-T G.821, G.823, G.826
Source Primary Power	-48 Vdc
Equipment Specifications	Per ITU-T G.783
Tributary, Electrical Interface	Per ITU-T G.703, 75 Ω
Ethernet Interface	10/100 Mbps
SDH Bit Rates	Per ITU-T G.703
Optical Interfaces	Per ITU-T G.957, G.958
Frame and Multiplexing Structure forSDH	Per ITU-T G.707
Synchronization	Per ITU-T G.813
Management Functions	Per ITU-T G.774, G.784
Protection Architectures	Per ITU-T G.841
Built In Testing and Alarms	Per ITU-T G.774, G.783, G.784

NOTE

- Optical wavelength shall be selected considering the characteristics of the optical fibre and the link budget.
- **Eye Safety for Laser Equipment:** To avoid eye damage, when a receiver detects a line interruption, it is required that the optical power of the laser shall be reduced to safe limits on the transmitter in the opposite direction as per ITU-T G.958.
- In case other than FC-PC connector is provided in the equipment, suitable patch cord with matching FC-PC connector are to be provided to connect with FODP.

1.3.2 Optical Link Performance Requirements:

The optical fibre link performance requirements are specified as follows:

1.3.2.1 Link Budget Calculations:

The fibre optic link budget calculations shall be calculated based upon the following criteria:

- (1) Fibre attenuation: The fibre attenuation shall be taken to be the guaranteed maximum fibre attenuation i.e. 0.21 dB/Km @1550nm and 0.35 dB/km @1310nm.
- (2) Splice loss: Minimum 0.05 dB per splice. One splice shall be considered for every 3 kms.
- (3) Connector losses: Losses due to connectors shall be considered to be minimum 1.0 dB per link.
- (4) Equipment Parameters: The equipment parameters to be considered for link budget calculations shall be the guaranteed “End of Life (EOL)” parameters. In case, the End of Life parameters are not specified for the SDH equipment, an End of Life Margin of at least 2 dB shall be considered and a similar margin shall be considered for optical amplifiers.
- (5) Optical path Penalty: An optical path penalty of at least 1 dB shall be considered to account for total degradations due to reflections, inter symbol interference, mode partition noise and laser chirp.
- (6) Maintenance Margin: A maintenance margin of at least 2.5 dB/100Km shall be kept towards cabling, repair splicing, cable ageing and temperature variations etc.
- (7) Other losses: Other losses, if any required specifically for system to be supplied shall also be suitably considered.
- (8) Dispersion: The fibre dispersion shall be taken to be the guaranteed maximum dispersion i.e. 18 ps/nm.Km @1550 nm & 3.5 ps/nm.km @ 1310 nm for DWSM fibres.

- (9) Bit Error Rate: The link budget calculations shall be done for a BER of 10^{-10} .

The bidders shall determine the total link loss based on the above parameters and shall submit the system design (including link budget calculations) for each category of fibre optic link in the Bid. For finalising the FOTS system design & BOQ, above methodology shall be adopted taking into account fibre attenuation, dispersion and splice loss determined during the detailed engineering. Accordingly, additions and deletions from the contract shall be carried out based on unit rates indicated in the contract.

1.3.2.2 Link Performance:

The Link performance for ES, SES and BER for the fibre optic links shall correspond to National Network as defined in ITU-T G.826.

1.3.2.3 FODP to SDH Equipment Optical Amplifier Connectivity:

The Contractor shall be responsible for connectivity between the FODP and the SDH equipment. The Contractor shall provide FC PC coupled patch cords. The location of FODP shall be finalized during detailed engineering. The patch-cord length between the FODP & equipment rack shall be suitably protected from rodents, abrasion, crush or mechanical damage.

1.4 Termination Equipment Subsystem:

The Termination Equipment Subsystem is defined to include the equipment that interfaces (adapts) the subscriber (user) to the Fibre Optic Transmission System (FOTS). A Functional description of these equipment are as follows:

1.4.1 Functional Description:

The transmission network node provides subscriber interface to the transmission network and/or switching/routing. For clarity, the basic functions accomplished at the network nodal points, are described briefly as follows:

Primary Multiplexer shall be used to accomplish subscriber connectivity to the Digital Communication Network. Subscriber Line Units shall provide analog to digital and direct digital conversion to 64 Kbps digital channel. In the CEPT standard hierarchy, thirty (30) such 64 Kbps digital channels shall be Time Division Multiplexed (TDM) resulting in a single 2.048 Mbps (E-1) digital bit stream.

Digital Drop-Insert and Branching Equipment shall be used to digitally interface a small number of channels at spur locations without requiring successive D/A and A/D conversions of the throughput channels.

Digital Cross connect Equipment (DACs) shall be used to provide

software controlled dynamic routing/rerouting of the primary (E-1) bit stream as well as the 30 channels of the E1 bit stream.

The equipment shall also have an interface for external 2048 kHz synchronization signal according to ITU-T Recommendation G.703.

1.4.2 First Order (Primary) Multiplexing:

The Contractor shall be required to provide E-1 Drop & Insert Multiplexer and E-1 Channel Bank primary multiplexing in compliance with the electrical input-output characteristics provided in **Table 1.3**.

1.4.2.1 Drop & Insert Primary Multiplexing:

Drop & Insert primary multiplexing in conformance with CEPT E-1 characteristics shall be required at locations where the subscriber requirement is minimal. The drop and insertion of up to thirty 64 Kbps channels supporting subscriber line units (SLU) shall be required at intermediate locations. The Drop & Insert Muxes supplied shall be performance and card compatible with the Channel Bank Equipment provided so that all Subscriber Line Interface cards are interchangeable.

Table 1.3
CEPT E-1 Standard First Order Multiplexing
Electrical Input / Output Characteristics

Applicable Standards:	CEPT per CCITT Recommendation G.702, G.703, G.711 and G.712
Number of Tributaries:	30 X 64 Kbps
Alternative Tributaries:	Sub-rate n X 64 Kbps V.36 64Kb/s V.11/V.36
Output Aggregate Rate: Interface Code: Impedance: Peak Level @ 120 ohm: Peak Level @ 75 ohm: Maximum Insertion Loss:	2.048 Mb/s \pm 50 ppm HDB3 75 ohm unbalanced 3.0 volts \pm 10% 2.37 volts \pm 10% db
Signal Waveform: Frame Structure: Jitter Performance:	Per CCITT G.703 Per CCITT G.742 Per CCITT G.823
Power Supply Voltage:	-48 Vdc

1.4.2.2 Channel Banks (Mux, Drop/Insert)

User voice and data equipment interfacing requirements are defined at the subscriber line level. Primary multiplexing in conformance with CEPT E-1 characteristics shall be used to provide first order multiplexing of up to thirty 64 Kbps channels supporting Subscriber Line Units (SLUs).

1.4.2.3 Subscriber Line Units\Subscriber Line Interface Cards

The terms Subscriber Line Interface Cards and Subscriber Line Units have been used interchangeably throughout the specification. Multiple configurations of SLUs shall be required to provide subscriber to primary multiplexer Bank interfacing for a variety of voice and data communications.

In case there are changes in number or type of cards because of changes in channel requirements, the contract price shall be adjusted accordingly.

The SLU interface requirements are discussed in the following

subparagraphs:

(A) Voice Channels:

The voice channel requirement is for (I) 4-Wire E&M trunking in support of PABX trunks & PLCC VF and (II) 2-Wire telephonic interfaces. 2 wire SLU shall be DTMF/TP optioned for 2-wire loop start or 2-wire GND start. The voice cards shall utilize ITU.T A - law companded PCM G.711, 64k bits/s encoding.

(B) Sub-Channel Data Multiplexing:

For this Project, the RTU data interface to the wideband telecommunications network node shall be defined at the DTE level at low-speed rates of 300,600 and 1200 baud. The port shall be compatible with RS232C interface. The Contractor shall be required to furnish 64 Kbps SLU asynchronous dataplexing for at least 4 selectable low speed DTE interfaces whenever multiple asynchronous data circuits are required.

(C) Synchronous Data:

The Contractor shall provide a direct DTE interface for synchronous communications at speed of 64Kbps and compatible with CCITT G.703 Kbit/s, V.35 and X.21 interfaces. Data rate selection shall be switchselectable or programmable.

(D) Nx64 kbps Synchronous Data

There is also a requirement for N x 64 kbps V.35, X.21 interfaces. However the final BOQ shall be worked out during detailed design and contract price shall be adjusted accordingly.

1.4.3 Digital Access Cross connect System:

The Contractor shall be required to provide Digital Access Cross connect Systems (DACS) capable of switching 16 or more E-1 lines in compliance with the electrical input-output characteristics provided in **Table 1.4**. DACSs shall be fully compatible with CEPT E-1 tributary standards.

DACSs shall be used to establish and reconfigure cross-connections at the tributary level of up to 480 x 64Kb/s channels. DACS E-1 line interface shall be fully capable of accessing each E-1 line.

Within the context of this specification, sizing of DACS system is defined as $4 \times n$ where n is the maximum size of the port switching matrix. Thus a DACS sized as 8×16 means that 8 E1 ports are interfaced over a 16 port(E1) matrix.

A DACS system shall consist of the switch matrix, all routing logic and timing circuitry for internally sourced, line derived or externally supplied network timing and full software support.

The DACSs to be provided under this contract shall consist of at least a 16 port switching matrix, with 16 ports equipped, i.e. 16×16 size. The DACS shall also be able to switch the signaling of the voice channels along with the voice channels. The DACS shall not use, decrease or block the specified capacity of the switching matrix while switching the signaling. The DACS shall support the Channel Associated Signaling (CAS) and Common Channel Signaling (CCS) both as per ITU-T G. 704.

The DACS shall provide user friendly control and management software. The user shall be able to operate the DACS locally through craft terminal, via an RS-232 interface or remotely under TMN supervisory control.

Table 1.4
CEPT E-1 Digital Access Cross Connect System
Required Operating Characteristics

E-1 Trunk Capacity:	Minimum 16-Port Switch Matrix Minimum 4-Port I/O per card
Tributary Capacity:	30 X 64 Kbps
Compatibility:	CEPT E-1, CEPT E-1 tributary channel
Frame Delay:	Minimum < 1 frame Maximum < 2 frames
E-1 Port Interface:	2.048 Mb/s \pm 50 ppm
Interface Code:	HDB3
Impedance:	75 ohm unbalanced
Peak Level @ 75 ohm:	2.37 volts \pm 10% 6
Maximum Insertion Loss:	db

Signal Waveform:	Per CCITT G.703
Frame Structure:	Per CCITT G.742
Jitter Performance:	Per CCITT G.823
Synchronisation:	Internal, external source and synchronized on incoming E-1
Routing: Routing Table Capacity:	Fully non-blocking tributary to/from E-1 channel Minimum of 9 routing tables for reconfiguration
Supervisory Ports: Supervisory Port Interface: Interface:	Serial Com Ports RS-232 Standard ASCII ANSI compatible terminal
Supervisory Channel:	Async data rates, software selectable: speed of 110-9600 bps, odd or even parity 7 or 8 bits.
Power Supply Voltage:	-48 VDC

1.4.3.1 Required DACS Applications:

The DACS provided shall be fully capable of implementing standard applications such as "Groom and Fill", Drop & Insert/Bypass, Broadcast and Alternative Routing.

1.4.3.2 Menus and Reports:

DACSs throughout the network shall be required to function as fully integrated subsystems of the Telecommunications Management Network (TMN) commissioned at SLDC.

The DACS software shall provide menu driven management of DACS and shall provide at least the following:

(I) Active Configuration: The user shall be able to modify the current active configuration.

(II) Configuration: The configurations other than the active one shall be listed, edited, viewed, renamed, deleted and activated. Actions shall be allowed manually, upon a carrier failure or specified alarm condition, remotely or on a scheduled basis.

(III) Reports: The user shall have selection of pre-formatted specific reports and "Report Options" to be used to select where the next reports will be sent.

(IV) Administration: This shall provide the user, options to control, view and maintain various logs and the DACS software.

(V) Alarms: This shall display Alarm Status on all active ports and shall have an alert mechanism that readily identifies an alarm event to the user through TMN (locally as well as remotely). The alarms shall have different colours based on the importance of the alarm.

1.5 MDF, DDF and Cabling

For the purposes of the specification, the contractor shall provide cabling, wiring, DDF patching facilities and MDFs interfacing to the wideband telecommunications system. Equipment and material components for MDF, DDF and cabling are also part of this procurement. It shall be the Contractor's responsibility to provide all cable support required for full supplied equipment interconnection with the MDF and shall be in accordance with communications industry standard practices and the requirements mentioned in the technical specifications.

1.5.1 MDF and DDF Patching Facilities:

The Contractor shall supply and install all cabling, wiring, connectors, cross connects, Digital Distribution Frames (DDF) and Main Distribution Frames (MDF) associated with the installation and interconnection of equipment procured under this package equipment being procured under other packages and existing/constituent owned equipment as follows:

- (i) DDF for termination of new SDH equipment E-1 ports
- (ii) Cabling (including connectors) for E1 level connections from DDF to existing SDH equipment, DDF to Existing & new PDH equipment and DDF to un-licensed Radio equipment. To the extent possible, existing cable at site shall be used.
- (iii) All Ethernet ports shall be terminated with RJ-45 connector. Provision for 100% expansion with connector for terminating additional Ethernet ports shall be provided.
- (iv) MDF for termination of all the subscriber channels at new PDH node
- (v) Cabling and connectors required to enable subscriber-to-subscriber circuits over the telecom network. The Line side of the MDF shall be cabled to the Primary Multiplex and the equipment side shall be cabled to the MDF of the assigned subscriber (PLCC, PABX, Telephone at wideband locations etc).

- (vi) Any other cables, connections etc required for a fully functional, integrated telecom system.

The connections amongst various equipment such as FOTS, termination equipment and subscriber MDFs etc shall always be routed through DDF and MDF to provide maintenance access.

1.5.1.1 Digital Distribution Frame Functional Requirements:

The Contractor shall provide DDF for Digital Signal Cross connect (DSX) Broadband-quality (better than 20 MHz) patching facilities configured "normally-thru" with Equipment, Line and Monitor Patch Jacks. DDFs shall provide the following basic functions:

- (i) "Normally thru" circuit routing
- (ii) Circuit rerouting via patch cord assemblies
- (iii) Circuit disconnect and termination

All DDFs shall be sized and equipped to support the offered configuration of the provided equipment. Independent Transmit and Receive patch jack assemblies (line and equipment) shall provide for separate transmit and receive single-plug patching. Transmit and receive patch jack assemblies shall be located side-by-side such that dual-plug patch cord assemblies may be used to route both transmit and receive for the same circuit.

1.5.1.2 Main Distribution Frames

The Contractor shall make provision for cross connection of subscriber services to the subscribers utilizing Krone type or equivalent and shall provide full connectivity up to and terminated on the equipment side of the appropriate DDFs and line side of MDFs. The Contractor shall terminate on the equipment side of patching facilities provided by other contracts and shall provide DSX type patching facilities supporting aggregate bit streams (i.e. dataplexers and E-1 Channel Banks). Separate Patch panels or MDFs shall be provided for Data and Voice. All cross connects shall be accomplished utilizing one, two or three pair patch cords. Patch plugs are permissible for direct one-to-one circuit "cut-thru".

1.6 Patch Cords:

The Contractor has to supply FC PC coupled Patch cords as described in BOQ. The Patch cord return loss shall be equal to or better than 40 dB and insertion loss equal to or less than 0.5 dB.

1.7 Telecommunication Management Network / Network Management System

The Contractor shall take responsibility for operational support to the

FOTS and associated interface with existing Telecommunications Management Network System (TMN) commissioned at SLDC. This TMN shall provide the capability to monitor, reconfigure, and control elements of the telecommunications network from a centralized location and at each node of the network where equipment is located. This TMN system shall assist Employer/Owner in the operations and maintenance of the wideband communication resources of the including detection of degraded circuits, system performance, the diagnosis of problems, the implementation of remedial actions and the allocation or reallocation of telecommunications resources and addition/deletion of network elements.

1.7.1 Performance Management

Performance management is concerned with evaluation of the use of network equipment and their capability to meet performance objectives. Minimum specific requirements that shall be satisfied include the following:

- a. Provide support for an operator to initiate, collect, and terminate performance metrics under both normal and degraded conditions. For example, BER of each link, together with other data measured at each node, shall be available on operator request.
- b. Monitor point to point & end to end signal quality and history. Provide operator controls to monitor performance of specified events, measures, and resources. Specifically provide displays to permit the operator to:
 1. Select/deselect network equipment, events, and threshold parameters to monitor
 2. Set monitoring start time and duration or end time
 3. Set monitoring sampling frequency
 4. Set/change threshold values on selected performance parameters
 5. Generate alarm events when thresholds are exceeded.
 6. Set multiple thresholds on certain performance parameters. Alarm categories include as a minimum a warning and a failure.
 7. Calculate selected statistical data to measure performance on selected equipment based on both current and historical performance data maintained in performance logs. Performance data provided is limited to what is available from the equipment Contractors.

8. Provide graphical displays of point to point and end to end current performance parameter values. Provide tabular displays of current, peak, and average values for performance parameters.
9. Generate reports on a daily, weekly, monthly, and yearly basis containing system statistics.

1.8 Communication Channel requirement & Integration:

The NMS information of existing PDH & SDH system shall be transported through the new communication network up to the NMS location i.e., at SLDC, Bhubaneswar. The NMS information of the new SDH & PDH system being procured under both the packages shall be transported through the existing communication network using 64 kbps/2Mbps (G.703) interfaces. Hence new SDH & PDH system being procured under both the packages is required to run on the existing NMS.

The bidders shall describe in the proposal the TMN data transport proposed to be used by the bidder in detail including capacity requirements and various components/equipment proposed to be used.

1.9 Craft Terminal:

Each equipment (SDH equipment, Mux, Drop/Insert and DACS etc.) on the fibre optic communication network shall include provision for connecting a portable personal computer (PC)/ Laptop to be known as craft terminal to support local commissioning and maintenance activities. Through the use of this PC and local displays/controls, the operator shall be able to:

- a. Change the configuration of the station & the connected NEs.
- b. Perform tests
- c. Get detailed fault information

The craft terminal shall be connected to the interface available in the communication equipment. Portable (laptop) computers (Craft terminals), each complete with necessary system and application software to support the functions listed above, shall be supplied to OPTCL as per BOQ.

1.9.1 Hardware Requirement:

The craft terminal (Laptop) shall have suitable processor(s) which shall be sufficient to meet all the functional requirement and expansion

capabilities stipulated in this specification. Only reputed make like Dell, IBM, HP, Compaq make shall be supplied.

The craft terminal shall have minimum configuration of 2.4 GHz, 2 GB RAM, 256 MB VRAM, DVD RW drive, 320 GB Hard Disk Drive, keyboard, mouse/trackball etc., parallel, serial/USB (2.0) ports to accommodate printers, and Internal/external Data/Fax modem and a battery back-up of at least 120 minutes. VDUs shall be 15" TFT active matrix color LCD with a minimum resolution of 1024 X 768.

1.10 General Software/Firmware Requirements:

Due to various alternative design approaches, it is neither intended nor possible to specify all software and firmware characteristics. It is the intent herein to provide design boundaries and guidelines that help to ensure a demonstrated, integrated program package that is maintainable and meets both hardware systems requirements and the customer's operational requirements.

1.10.1 Operating System Software:

Operating system software shall be provided to control the execution of system programs, application programs, and management devices, to allocate system resources, and manage communications among the system processors. The contractor shall make no modifications to the OEM's operating system, except as provided as USER installation parameters.

1.10.2 Applications Software:

All applications software shall be written in a high-level programming language unless developed using industry proven application programs and development tools provided with the system. The contractor shall make no modifications to the applications program except as provided as USER development tools.

1.10.3 Software Utilities:

A utility shall be provided to convert all reports into standard PC application formats such as excel.

1.10.4 Revisions, Upgradations, Maintainability:

All firmware and software delivered under this specification shall be the latest field proven version available at the time of contract approval. Installed demonstration for acceptance shall be required. All firmware provided shall support its fully equipped intended functional requirements without additional rewrite or programming.

All software shall be easily user expandable to accommodate the

anticipated system growth, as defined in this specification. Reassembly recompilation or revision upgrades of the software or components of the software shall not be necessary to accommodate full system expansion.

Software provided shall be compliant with national and international industry standards.

1.10.5 Help:

All applications shall be supported by USER accessible HELP commands that shall assist the user in the performance of its tasks. HELP commands for an application shall be available to the user from within the active application and shall not interfere with the activities of the application.

GUARANTEED TECHNICAL PARTICULARS OF FOTE

	Particular	Unit	Required
1	2	3	4
1	General		
a	Type of multiplexer		SDH+PDH
b	Complying to ITU-T rec.		Yes
c	Transmission Capacity	Mbit/s	STM-4: 620 Mbps
d	Upgradable Capacity	Gbps	STM16
e	Redundant central processor (SDH/PDH)		Shall be available
f	PDH cross connect capacity		Minimum 120x2Mbit/s
g	The equipment is type tested		Yes
h	Minimum no of protected (MSP) direction	Nos	Five
2	Available SDH ports:		
a	SDH based on SFP technology		Yes
b	Optical line interface card (to support up to 160 Kms)		Yes
c	Electrical SDH interfaces		STM1 : 16 minimum
d	Optical SDH interfaces		STM4 : 16 minimum
3	Tele protection Interfaces		
a	Integrated Distance Tele protection Interface		Yes
b	Integrated Optical Tele protection Interface		Yes
c	Addressing of protection commands		Yes
d	Loop Test for measuring delay time		Yes
e	Interface for Commands Tx Rx for DPS		4 Commands/interface
f	Number of Independent commands Min/Max/	Number	4 Commands/32 commands
g	Transmission time max.	ms	6

h	Protection voltage max.	VDC	250
i	1+1 com path protection		Yes
j	Digital display type counter module to count Tx & Rx Commands operation for each command with count storage circuitry selectable working voltage 48V/110V/220V and with arrangement on front of module to reset counter (Tx & Rx) for each command separately		Yes
4	User Interfaces		
4.1	Voice Interfaces for trunk lines:		
a	Minimum number of channels per card	Nos.	8
b	Analogue, 4wire with E&M: Input level Output level	dBr	+9.5 to -16/+7.0 to -16.5
c	Analogue, 2wire with E&M: Input level Output level	dBr	+9.5 to -12.5-1.0 to -20
4.2	Voice Interfaces for remote subscriber:		
a	2wire, subscriber side	dBr	-5to+4 / -7.5to-1
b	Minimum number of subscriber	Nos.	10
5	Data module		
a	V.24/V.28 (RS-232) minimumports/interface	Nos.	4
b	V-35 minimum ports/interface	Nos.	4
c	Integrated LAN port available of DATA Interface		Yes
d	Software programmable board available to assign different types of data interface to each port		Yes
6	Ethernet interface		
a	Ethernet: ports (Optical/Electrical)	No.	4 ports
b	Ethernet: Router functionality		
	Routing protocols		Static IP route OSPF
7	Integrated alarm gathering module:		
a	Number of external alarms per module	No.	8
8	Configuration Management		
	Type/Name of configuration tool		
a	For local/remote operation		Yes/Yes
b	Data communication network (DCN)		Ethernet /IP
c	Integrated management for SDH/PDH		Yes
9	Network Management System		
	Type/Name of configuration tool		
a	For local/remote operation		Yes/Yes
b	Data communication network (DCN)		TCP/IP
c	Integrated management of SDH/PDH		Yes
10	Power Supply		
a	Operation	VDC	48

b	Fully redundant power supply (for SDH/PDH)		Yes
c	Dual power feeder		Yes
d	AC power supply	VAC	230

GUARANTEED TECHNICAL PARTICULARS OF OPGW CABLE & HARDWARE ACCESSORIES

GUARANTEED TECHNICAL PARTICULARS OF FOTE

	Particular	Unit	Required
1	2	3	4
1	General		
a	Type of multiplexer		SDH+PDH
b	Complying to ITU-T rec.		Yes
c	Transmission Capacity	Mbit/s	STM-4: 620 Mbps
d	Upgradable Capacity	Gbps	STM16
e	Redundant central processor (SDH/PDH)		Shall be available
f	PDH cross connect capacity		Minimum 32x2Mbit/s
g	The equipment is type tested		Yes
h	Minimum no of protected (MSP) direction	Nos	Three (expandable up to four MSP directions of which at least two directions support STM-16)
2	Available SDH ports:		
a	SDH based on SFP technology		Yes
b	Optical line interface card (to support up to 160 Kms)		Yes
c	Electrical SDH interfaces		E1, Electrical interface
d	Optical SDH interfaces		6 ports minimum
3	Teleprotection Interfaces		External Teleprotection interface via G.702(2mbps,E1). There shall be option for the interface of future integration of protection coupler.
4	User Interfaces		
4.1	Voice Interfaces for trunk lines:		
a	Minimum number of channels per card	Nos.	8

b	Analogue, 4wire with E&M: Input level Output level	dBr	+9.5 to -16/+7.0 to -16.5
c	Analogue, 2wire with E&M: Input level Output level	dBr	+9.5 to -12.5-1.0 to -20
4.2	Voice Interfaces for remote subscriber:		
a	2wire, subscriber side	dBr	-5to+4 / -7.5to-1
b	Minimum number of subscriber	Nos.	10
5	Data module		
a	V.24/V.28 (RS-232) minimumports/interface	Nos.	4
b	V-35 minimum ports/interface	Nos.	4
c	Integrated LAN port available of DATA Interface		Yes
d	Software programmable board available to assign different types of data interface to each port		Yes
6	Ethernet interface		
a	Ethernet: ports (Optical/Electrical)	No.	Ethernet-4 ports(Electrical) Required and there shallbe option for Ethernet port (optical) for future interface of optical signal
b	Ethernet: Router functionality		
	Routing protocols		Ethernet interface unit with layer-2 switching functionality.
7	Integrated alarm gathering module:		
a	Number of external alarms per module	No.	8
8	Configuration Management		
	Type/Name of configuration tool		
a	For local/remote operation		Yes/Yes
b	Data communication network (DCN)		Ethernet /IP
c	Integrated management for SDH/PDH		Yes
9	Network Management System		
	Type/Name of configuration tool		
a	For local/remote operation		Yes/Yes
b	Data communication network (DCN)		TCP/IP
c	Integrated management of SDH/PDH		Yes
10	Power Supply		
a	Operation	VDC	48
b	Fully redundant power supply (for SDH/PDH)		Yes
c	Dual power feeder		Yes
d	AC power supply	VAC	230

PART-20
**CCTV CAMERA (VIDEO MANAGEMENT
SYSTEM)**

TECHNICAL SPECIFICATION FOR VIDEO MANAGEMENT SYSTEM

General Description:

The Video Management System (VMS) shall be a Microsoft Windows-based video management and surveillance system consisting of two primary components, as follows:

1. An IP video management system. This application shall:
 - a. Maintain the database of cameras and recording devices and to provide a web-based administrative portal to manage the video surveillance system
 - b. Route video traffic to users as requested and appropriate
 - c. Record and store video from resources on the network.
2. A client presentation application to allow users to view and manage live and recorded video.

IP Video Management System Description:

- i. The Video Management System (VMS) shall be a Microsoft Windows-based video management and surveillance system consisting in a single server performing the following functions:
 1. Allow users to define users and assign sets of permissions (known as roles) to each user.
 2. Record and store video per user-defined retention settings for up to 20 cameras per server.
 3. Serve live and recorded video to clients on demand
- ii. The IP video management system shall record video and audio streams from IP cameras and video encoders on the network.
 1. Video: H.264 in High, Main, or Base Profile streams from both standard resolution and megapixel cameras
- iii. The system shall support recording schedules, including the ability to record based on motion, analytic, and alarm events.
- iv. The IP video management system shall be capable of continuous scheduled alarm/event and motion recording. Pre- and post- alarm recording shall also be available and shall be fully programmable on as per channel basis.
- v. The IP video management system shall have the ability to record and playback audio streams along with associated video.
- vi. The IP Video Management System shall support recording of primary or secondary streams.
- vii. The IP Video Management System shall support video bookmarking, such that users can identify and recall important moments in recorded video.
- viii. The IP video management system shall allow the administrator to set minimum and maximum retention periods for recorded video.

- ix. The IP video management system shall support network health and monitoring utilizing third- party SNMP monitoring tools.
- x. The IP video management system shall indicate system performance and operation status utilizing a variety of reports.
- xi. The system shall be configurable remotely or over a network.
- xii. The system shall discover both OEM and 3rd-party cameras on the network.
- xiii. The system shall allow users to manually add cameras and devices by IP address.
- xiv. The system shall allow users with sufficient rights to control cameras (pan, tilt, and/or zoom).
- xv. The system shall support aggregation by a higher-level system, tying multiple VMS servers together in a single, unified environment.
- xvi. The system shall support third-party cameras using ONVIF profiles S and G or native drivers.
- xvii. The IP VMS shall support Lightweight Directory Access Protocol (LDAP) to authenticate users.
- xviii. The IP video management system shall allow archival of video data to external network locations or NAS devices over a network connection. The archival schedule shall be either automatic at user-defined intervals or manually executed.
- xix. The video management system shall be available as a hardware server with capacity to record 20 cameras at up to 200mbps recording throughput.
- xx. The video management system shall be available as a software product that can be installed on COTS hardware.
- xxi. The server shall support semantic grouping and organization of cameras/devices into groups using “tags”.
- xxii. The system shall allow users to export video on request; exported video shall be stored locally on the server or on another network location selected by the administrator.
- xxiii. The system shall support aggregation by a higher-level environment, allowing the IP video management system to belong to a confederation of servers.
- xxiv. Specifications / Minimum System Requirements:
 - 1. Processor: Intel Xeon E3-1220 v5
 - 2. Operating System: Microsoft Windows 10 IoT Enterprise 64-bit (LTSB)
 - 3. RAM: 8 GB
 - 4. SSD Storage: 120 GB
 - 5. HDD: Up to 12 TB (Minimum 3 Slots)
 - a. RAID Level: RAID 5 / JBOD
 - 6. Video
 - a. Outputs:
 - i. VGA

7. USB Ports:
 - a. USB 2.0: 2x Front; 1x Rear
 - b. USB 3.0: 1x Rear
8. Networking: 2x Gigabit Ethernet (1000Base-T) Ports
9. Throughput 200 Mbps

30X, 2Mpx High speed PTZ Dome Camera:

<u>Sr. No:</u>	<u>Specification:</u>	<u>Parameter:</u>
1	Image sensor	1/3-inch CMOS Sensor
2	Resolution	1920 X 1080
3	Frame per Second	60 FPS
4	Dynamic Range	100 dB or better
5	Signal to Noise Ratio	>45 dB
6	Minimum Illumination	Color 0.07 lux ; Mono 0.02 lux
7	IR Illumination	150 Meter or better
8	Lens	4.3 mm (wide) ~ 129.0 mm (tele)
9	Optical Zoom	30X
10	Digital Zoom	32x
11	Horizontal Angle of View	58.9° (wide) ~ 2.11° (tele)
12	Iris Control Auto	iris
13	Back Light Compensation	Yes
14	Digital Image Stabilization	yes
15	Active Noise Filtering	3D Noise Filtering
16	Presets	256 preset
17	Tours	16
18	Window Blanks	16
19	Preset Accuracy	±0.1°
20	Pan & Tilt Speed	Up to 300° per second/Up to 145° per second
21	Vertical Tilt	+15° to -90° degrees
22	Video Streams	Up to 3 simultaneous streams
23	Audio Input/output	Yes
24	Supported Protocols:	TCP/IP, UDP/IP (Unicast, Multicast IGMP), UPnP, DNS, DHCP, RTP, RTSP, NTP, IPv4, IPv6,SNMP v2c/v3, QoS, HTTP, HTTPS, SSH, SSL, SMTP, FTP, and 802.1x (EAP)
25	Local Storage	Up to 2TB storage card
26	Analytics Motion	Detection and Camera Sabotage
27	Pan Movement	360° continuous pan rotation
28	Alarms	2 X inputs and 2 X relay output
29	Input Power	802.3bt, 24 VAC and 48 VDC
30	Operating Humidity	0 to 90% RH (condensing)
31	Environmental Protection	Ingress for Water & Dust - IP66 or higher
32	Certificates	CE & FCC & UL cUL
33	ONVIF Compliant ONVIF	Profile S and Profile G conformant

PART-21
220V BATTERY & BATTERY CHARGER

CONTENTS

Part A

TITLE

[Lead Acid Plante Storage Battery)

SCOPE:

Standards

Installations

Particulars of the System

General Requirement of the equipments.

Details of specifications of plante Batteries.

Design & construction details.

Installation of battery.

Connectors.

Accessories.

Maximum Short circuit current.

Ventilation.

Capacity.

Charging.

Life.

Instruction Manuals.

Transport.

Tests.

Drawings/documents.

Guaranteed Tech. Particulars.

Part – B [CHARGER]

TITLES:

Brief description

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Cubicle

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Transport

Tests

Drawings / documents

Special tools, plants, and spares

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General Technical requirements for Battery Charger

GTP for 220V Lead Acid Plante storage battery.

GTP for Battery Charger

Quantity and delivery schedule

Calibration status of meters & equipments or

Testing for battery

Calibration status of meters & equipments for testing of
battery charger.

Check list towards Type Test reports for
battery.

Check list towards Type Test reports fo
battery charger.

Check list for delivery schedule

**TECHNICAL SPECIFICATION FOR 220 VOLTS LEAD ACID PLANTE
STORAGE BATTERY**

1. SCOPE

These specifications cover the design, manufacturer, assembly, shop testing at manufacturer's works before despatch, supply and delivery at SITE and erection testing and commissioning of 220V, 350AH (110 cells) lead Acid Plante Storage batteries along with the required accessories and fittings etc.,

The scope of supply shall include all parts and accessories etc. which are usual and necessary for erection, operation and maintenance of the Plante type battery banks and the chargers, as specified, above though not individually and specifically stated or enumerated.

2. SITECONDITIONS:

The material to be supplied against this specification shall be suitable for satisfactory continuous operation under the following Topographical and Meteorological conditions.

S.NO	PARTICULARS	CONDITION
1	Maximum ambient air temperature	50deg C
2	Minimum ambient air temperature	5deg C
3	Average ambient air temperature	32 deg C
4	Maximum Relative Humidity	100%
5	Maximum altitude above mean sea level	Below 1000m
6	Maximum wind speed	50 m/s
7	Isokeraunic level	70 Days/year
8	Seismic level	Zone-3

3. CODES AND STANDARDS:

3.1 The equipments shall comply in all respects with the latest edition of relevant Indian Standard Specifications except for the modifications specified herein. The equipments manufactured according to any other authoritative national / international standard which ensure an equal or better quality than the provisions of these specifications shall also be acceptable. Where the equipment offered conform to any other standard, salient points of differences between the proposed standard and the provisions of these specifications shall be clearly brought out in the tender. A Xerox copy of such standards [in English shall be enclosed with the offer].

A LIST OF RELEVANT STANDARDS IS GIVEN BELOW :

- [i] IS-1652-1991 - Specification for stationery cells and batteries, lead Acid type with Plante Positive Plates

[ii]	IS: 266-1993	-	Specification for Suphuric Acid.
[iii]	IS-6071-1986	-	Specification for synthetic separators for lead acid batteries.
[iv]	IS: 1069-1993	-	Specification for quality tolerances water for storage batteries.
[v]	IS: 1146-1981		Specification for rubber and plastic Containers for lead acid storage batteries.
[vi]	IS: 8320-2000	-	General requirements and methods of tests for lead-acid storage batteries.
[vii]	IS: 1885-Part-8/1996	-	Electro technical vocabulary-stationary cells & batteries.
[viii]	IEEE-485/1983	-	IEEE recommended practice for sizing large lead storage batteries for generating stations and sub-stations.

INSTALLATIONS:

Equipment covered under these specifications shall be suitable for indoor installation.

PARTICULARS OF THE SYSTEM:

One set of 220 Volts, 350AH capacity battery along with equipment such as boost charger, trickle charger shall be sufficient to cater to the DC power requirements in the Sub-stations as proposed. The system offered should be suitable to OPTCL system.

GENERAL REQUIREMENTS OF THE EQUIPMENTS:

General requirement of the different components of the Battery system are given below.

Two sets of 220V,350 AH lead acid type plante storage battery set is required for meeting the D.C. load requirements of indicating lamps, emergency lighting, relays, alarms, circuits breakers etc. The battery shall be kept in healthy conditions with the help of the existing float charging unit. The existing boost charger unit shall supply quick charging current to bring back the battery to fully charged conditions after it has discharged to a considerable extent while meeting the emergency load. The battery shall meet practically all the heavy current demands, as required for operation [closing and / or operating of circuit breakers, emergency lighting load and field flashing load etc). It should be noted that, the 220V batteries are to be accommodated in the Battery Room and should operate satisfactorily over the entire range of ambient temperature of 0 deg C to 50 deg C and relative humidity of 95%.

DETAILS OF SPECIFICATIONS OF PLANTE BATTERIES Type Battery:

The batteries shall be made of closed type lead acid cells with 'plante' type plates manufactured to conform to IS: 1652-1991.

CAPACITY :

The capacity of the batteries shall be as follows :

- [i] Voltage. - 220V
- [ii] Output at 27 deg C - 350AH at 10 hrs. Discharge rate.

The batteries shall normally remain under 'floating' condition with the 'trickle' charger supplying the continuous load. However, the batteries shall be capable of supplying the following loads under emergency conditions without any assistance from the chargers and without their terminal voltage falling below 200 V [90% of rated voltage]

350AH

- [I] I stage [continuous] - 35A for 10 hours.
- [ii] Stage emergency - 15A for 3 hours for lighting.

The number of cells for the 220 V batteries shall be so chosen that for the nominal floating voltage of the cells, the battery voltage shall be 237.5V/51.85V and for the minimum [discharged condition] voltage of the cells, the voltage of the battery shall not be less than 198V/43.2V, while the assigned rating of the battery bank cannot be lowered below its rated voltage of 220 volts.

DESIGN AND CONSTRUCTION DETAILS: (For Plante Type)

Containers: The containers for the cells shall be of impervious, moulded transparent, plastic/glass material having heat-resisting, high strength, non-reacting and low inflammable properties conforming to IS-1146-1981. The containers shall be mounted on insulators blocks. The containers shall be of robust construction and free from flaws, bubbles or foreign matter. The surface of the containers shall have a finish substantially free from blisters, rough spots, scales, blow holes and other imperfections or deformations. The handle bars, if provided, shall be of such that sufficient sediment space shall be available and the batteries will not have to be cleared out during their normal life. Battery containers shall be subjected to type, Routine and Acceptance Tests as per the requirements of IS-1146-1981. The containers of the label attached firmly to the containers shall be marked with the information as per requirements of cl No. 2.2 of the above standard. The

supplier's manufacturer's test certificates shall be submitted by the tenderer for the scrutiny of the purchaser.

Plates: The positive plates shall be of pure lead lamelle type with plane formation. The negative plates shall be pasted antimonial-lead Grid type so designed as to hold the active material securely in place and in firm contact with the grid during service. The plates shall be designed for maximum durability and shall not buckle during all service conditions including high rate of discharge and the fluctuation of load.

Separators: The separators shall be of synthetic material conforming to the latest edition of IS-6071-1986. These shall permit free flow of electrolyte and would not be affected by the chemical reaction inside the cell and shall last for indefinite time. The internal resistance factor of the separators shall assure high discharge characteristics under all operating conditions. Proper arrangement to keep end plates in position shall be furnished by the bidder along with his offer.

Electrolyte: The electrolyte shall be prepared from the battery grade sulphuric acid conforming to IS-266-1993 and shall have a specific gravity of 1.2 at 27°C. The sulphuric acid of battery grade shall be colourless liquid. The concentrated sulphuric acid on dilution with an equal volume of distilled water shall be free from suspended matter and other visible impurities. The sulphuric acid shall meet the requirements of columns – 4 and 5 Table –1 of IS-266-1993. The requisite quantity shall be despatched in non-returnable containers suitably packed and marked as per the requirements of the above Indian Standards. The container materials and packing shall be subject to approval of the purchaser.

Sufficient quantity of distilled water conforming to IS-1069-1993 shall be supplied in non-returnable containers to correct the level of electrolyte during initial testing and commissioning. The material of containers and packing shall be subject to the approval of the purchaser.

Plate group bar with terminals: The plate group bar with terminals shall conform to IS-1652-1991. The positive and negative terminals shall be clearly marked for easy identification. The legs of the plates of like polarity shall be connected to the load, turned to a horizontal group bar having an upstanding terminal post adopted for connection to the external circuit. The group bars shall be sufficiently strong to hold the plates in position.

Buffers/spring: Suitable buffers / springs shall be provided in the cells to keep the end plates in position. These shall have adequate length and strength.

Cell lids: Lids used with sealed or closed type cells shall be of glass, plastic or ebonite and shall be provided with vent plugs. Terminal post shall be suitably sealed at the lid to prevent escape of acid spray, by means of rubber grommets, sealing compound or other suitable device. The positive and negative terminal posts shall be clearly and indelibly marked for easy identification.

Water: - Water used for preparation of electrolyte and also to bring the level of electrolyte to approximately correct height during operation / testing shall conform to relevant standards.

Venting device : The venting device shall be anti-splash type and shall allow gases to escape freely but shall effectively prevent acid particles or spray from coming out. There shall be two vent holes, one serving as a guide for acid level indicator for checking the electrolyte level and other to permit drawing of electrolyte samples, servicing, checking of specific gravity etc.

Marking: Acid level line shall be permanently and indelibly marked around on all the containers.

The following information shall be indelibly marked on the outside surface of each cell :

- [i] Manufacturer's name, type and trade mark.
- [ii] Nominal voltage.
- [iii] AH capacity at 10 hours rate with specified end cell voltage.
- [iv] Cell number.
- [v] Upper and lower electrolyte level in case of transparent containers.
- [vi] Type of positive plate.
- [vii] Type of container.
- [viii] Date of manufacture [month and year] or [week and year].

INSTALLATION OF BATTERY :

The battery set shall be installed on wooden racks in a separate battery room non air – conditioned but ventilated. The tenderer shall offer racks and mounting insulators etc.

The cell shall be arranged on the racks in a two-tier arrangement with two rows of cells on each tier or with some other suitable arrangement depending upon the availability of space inside the battery room. The lay out shall be subject to the approval of the purchaser. The racks shall be constructed of best quality seasoned **teak wood** / with metallic stand with at least three [3] coats of anti-acid paint of approved shade and also flame proof coating. These racks shall be such that cells are located at convenient height to facilitate maintenance and they may be so constructed so as to promote free access to the floor directly beneath the rack to facilitate easy cleaning of the floor. These shall be designed and arranged in such a way that easy handling of the cells is possible while in operation. Numbering tags for each cell shall be attached on to the racks.

The tenderer shall indicate and include the proposed arrangement of the batteries and include arrangement for fixing and mounting of inter-bank, inter-row, inter-cell and tap-off connectors etc.

CONNECTORS:

Bars tinned copper lead connectors shall be employed for Inter-cell and inter-row, inter-tier connections. However, the tee-off connection from the battery unit shall be made with acid resisting cables of suitable size. A suitable terminal box along with acid-resisting cable shall be provided by the tenderer for this purpose. The connectors shall preferably be of bolted type and the bolts and nuts shall be of similar material as that of connectors and shall be provided with corrosion resisting lead coating.

The connectors shall be of sufficient cross-section to withstand all the working conditions including one minute discharge rate as well as short circuit conditions.

ACCESSORIES:-

The equipment and accessories, listed below shall be furnished as part of each battery set and the price of the battery quoted shall be inclusive of these items.

- [i] Teak wood racks with three coats of anti-acid paint and flame-proof coating.
- [ii] Stand insulators +5% extra.
- [iii] Cell insulators +5% extra.
- [iv] All Cell interconnectors and end take-offs.
- [v] Lead coated connection hardware such as bolts, nuts etc.5% extra. Or any other connector suitable for VRLA type Battery.
- [vi] Cell numbering tags with fixing arrangement.
- [vii] Teakwood, cable clamps with hardware.
- [viii] Diluted sulphuric acid of sufficient quantity and of specific gravity according to the relevant ISS and 10% extra shall be supplied in non-returnable acid proof containers, suitable packed.
- [ix] Two numbers cell testing centre-zero voltmeters 3-0-3 volts range, Accuracy class shall be 0.5 or better and resistance not less than 1000 ohms.
- [x] One number syringe type hydrometer complete with accessories and suitable for measuring SP gravity between 1.1 to 1.320 with graduation of 0.005 Sp. Gravity together with temperature correction charts.
- [xi] One number floating hydrometer.
- [xii] Two numbers thermo-meters having range 0-100 deg. C whose one division of the graduated scale shall represent at the most 1 degree centigrade with separate gravity correction chart.
- [xiii] [Accuracy of calibration shall not be less than 0.50C]
- [xiv] One number wall mounting teak-wood for hydrometers and thermo-meters.
- [xv] Two numbers acid-resisting plastic jugs [2 litre capacity]
- [xvi] Two numbers plastic funnels.
- [xvii] Two numbers rubber syphons.
- [xviii] Two numbers rubber aprons.
- [xix] Two pairs of rubber gloves.

- [xx] Two pairs of rubber boots-knee height.
- [xxi] Two sets special tools or tools required for connecting the terminals of the batteries.
- [xxii] The battery terminals shall be brought out in a junction box to be mounted on the battery stands.
- [xxiii] Ampere-hour meter [10 hour discharge rate] of 600 –1250 AH range-1 no.
- [xxiv] Any other accessories, not specified but required for installation, satisfactory operation and maintenance of batteries for a period of 5 [five] years.

MAXIMUM SHORT CIRCUIT CURRENT :

The Bidder shall state the maximum short circuit current of each battery along with the safe duration in seconds which it can withstand. Methods, proposed to be adopted for protecting batteries from the short circuit conditions should also be stated to avoid damage to the battery and loss to the associated equipment.

VENTILATION :

The bidder shall indicate in his bid the requirements of ventilation in the battery room. The battery shall operate satisfactorily over the entire range of the temperature and humidity indicted in this specification without affecting its normal life. Bidder shall indicate the percentage reduction in battery capacity at the lowest temperature of 27 deg C. If any special ventilation requirements are necessary, the same shall be indicated.

CAPACITY :

The standard Ampere-hour capacity at ten hour rate shall be 350 AH with an end cell voltage of 1.85 volts/cell.

CHARGING :

The bidders shall state whether an equalizing charge is recommended for the battery. If so, the equalizing charge voltage, current, duration and the interval between the equalizing charging shall be specified in the Data sheet. Bidder shall also indicate the requirements for boost charging.

LIFE :

The bidder shall quote in his offer the guaranteed life of the battery when operating under the conditions specified.

INSTRUCTION MANUALS :

Eight sets of instruction manuals for installation, commissioning, charging and maintenance instruction shall have to be furnished.

TRANSPORT :

The batteries, accessories and racks etc. shall be suitably packed and transported to site.

TESTS:

TYPE TESTS:

The bidder shall submit the test reports along with his offer for the following type tests, conducted on the offered samples as per relevant National Standard[s] and test witnessed by any Government Department / Government undertaking, failing which the offer is liable for rejection.

- [a] Verification of constructional requirements.
- [b] Verification of dimensions.
- [c] Test for capacity.
- [d] Test for retention of charge.
- [e] Endurance Test.
- [f] Ampere-hour and watt-hour efficiency test.
- [g] Test for voltage during discharge.

If the type test report [s] does/do not meet the requirements as per this specification, OPTCL at its discretion may ask the supplier to conduct the above type tests [s] at the supplier's cost in the presence of OPTCL's representative without any financial liability to OPTCL

ACCEPTANCE TESTS:

Following shall constitute the acceptance tests which shall be test witnessed by the purchaser's representative at the works of the manufacturer at the cost of supplier.

- [i] Verification of marking.
- [ii] Verification of dimensions.
- [iii] Test for capacity for 10 hours discharge rate along with the Test for voltage during discharge.
- [iv] Ampere-hour and watt-hour efficiency test.

The Purchaser may at his discretion undertake test for capacity and voltage during discharge after installation of the battery at site without any extra cost.

The supplier shall arrange for all necessary equipment including the variable resistor, tools, tackles and instruments. If a battery fails to meet the guaranteed requirement, OPTCL shall have the option of asking the supplier to replace the same within 15 [fifteen] days from the date of declaring the same to be insufficient/failed / not as per the specification [s].

DRAWINGS / DOCUMENTS :

The tenderer shall submit the following drawings / documents along with his offer failing which the offer is liable for rejection.

- [a] General battery arrangement, proposed size of individual and over all dimensions along with sectional views showing all connections etc.
- [b] Pamphlets and technical literature giving detailed information of the batteries offered.

The manufacturer shall submit the following drawings / documents in 7 [seven] copies within 15[fifteen] days from the date of issue of the purchase order for purchaser's approval. :-

- [a] Lay out details of the batteries.
- [b] OGA and cross-sectional details for battery cells.
- [c] Instruction manuals for initial charging and subsequent charging.
- [d] Technical data, curves etc.

GUARANTEED TECHNICAL PARTICULARS :

The Guaranteed technical particulars, as called for in the 'Annexure – I & II shall be furnished along with the tender. Any tender lacking complete information in this respect is likely to be rejected.

All deviations from the specification shall be separately listed, in the absence of which it will be presumed that the provisions of these specifications are complied with by the tenderer.

ANNEXURE -1A

SPECIFICATION FOR 350AH 220 VOLT LEAD ACID PLANTE BATTERY SYSTEM

[To be filled in by the bidder]

SL. NO.	SPECIFICATION	CONFIRM /NOT CONFIRM
1	Lead Acid Plante type battery 350AH. 2V per cell	
2	The steel rack will be placed over porcelain. Hard rubber insulator of 100 mm Height [approx.] to minimize leakage current to ground	
3	All the battery cells are to be assigned with number	
4	The final positive and negative terminals are to be brought to the terminal plate assembly (TPA). Suitable arrangement should be made for terminating the cables at the TPA	
5	Test for capacity of batteries should conform to IS: 1652 (Clause 11.6)	
6	The battery should be supplied with all accessories like connectors, links, S.S. nuts. Bolts and insulator etc.	
7	All the portion of connectors and adjacent steel plates are to be sleeved and insulated.	
8	Discharge test of batteries at 10 hr. rate of discharge to end cell voltage of 1.85 volt per cell to conform to the requirement of IS: 1652. Clause - 11.7 (Test for capacity) should be carried out by the supplier at the works of manufacturer and at the site. The ambient temperature at the place of installations will be considered for the calculation period of discharge.	
9	The battery should have a life expectancy of minimum 8 years at battery room ambient temperature that varies from a minimum of 20 degree centigrade during winter season and a maximum of 50 degree centigrade during peak summer. The tenderer should submit the relevant technical literature preferably in pdf form with details design calculation graph documents etc. in support of indicated life of the battery taking care of the above seasonal ambient temperature variation.	
10	The supplier should submit the documentary evidence (P.O. copy) for supply, installation and commissioning of battery capacity of 350 AH or higher capacity to the PLCC. Systems under any GRID Sub-stations and the same is in successful operation for a minimum period of 5.	
12	The watt-hour and ampere-hour efficiency and internal resistance value of the battery should be furnished.	

13	The supplier should show the values of internal resistance of all the cells at the time of commissioning at site and the same should confirm to the value indicated by them in their technical bid.	
14	The procedure of charging the battery before the capacity test should be furnished. The battery et will be inspected tested at works before dispatch to store site.	

ANNEXURE IIA

SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS FOR 220 VOLT 350AH STORAGE BATTERY

(TO BE FILLED IN BY THE BIDDER)

1	Manufacturer's name and address :			
2	Conforming to standards.			
3	Type and designation as per IS.			
4	Manufacturer's type and designation			
5	Capacity of battery bank at the following discharge rates at 27 ⁰ C	Cap. AH	Rate of Disch. Current	End Cell voltage
	a. 15 minutes. b. 30 minutes. c. 45 minutes. d. 1 hour e. 2 hours f. 3 hours. g. 4 hours. h. 5 hours. i. 6 hours. j. 7 hours. k. 8 hours. l. 9 hours. m. 10 hours.			
6	Number of cells in the battery.			
7	Method of interconnection between cells.			
8	Maximum short circuit current of battery when short circuit is at the end of terminals			
9.	Recommended float-charging voltage across the battery terminals (volts).			
10	Recommended boost charging voltage across battery terminals (volts).			
11	Time required for boost charging from discharged conditions (in hours).			
12	Recommended trickle / float charging rate			
13	Recommended boost charging rate.			
14	Trickle charging current range / cell.			
15	Shelf life of charged battery bank.			
16	Open circuit voltage of battery bank when fully charged.			
17	AH capacity at 10 hours rate at room temperatures of:-			

	<ul style="list-style-type: none"> a. 15⁰C. b. 27⁰C c. 50⁰C
18	Cell Particulars:-
	<ul style="list-style-type: none"> Material of container. Overall dimensions of each cell. Weight of cell complete with acid.
19	Voltage:-
	<ul style="list-style-type: none"> a. Open circuit voltage of cells. b. Float charging voltage. c. Boost charging voltage.
20	Type of material / thickness / dimension of positive plates.
21	Type of material / thickness / dimension of negative plates.
22	Separators:-
	<ul style="list-style-type: none"> a. Type. b. Materials. c. Thickness of separator.
23	Type of valve provided.
24	Internal resistance of each cell at
25.	Clearance in mm between.
	<ul style="list-style-type: none"> a. Top of plates and top of container. b. Bottom of plates and bottom of container. c. Edges of plates and inner surface of container.
26	Maximum ambient temperature that the cells can withstand. Without injurious effect.
	<ul style="list-style-type: none"> a. Continuously. b. Short periods (duration to be stated along with temperature).
27	Maximum number of charge / discharge cycles that the cell can withstand.
28	Ampere-hour efficiency at ten-hour discharge rate.
29	Watt-hour efficiency at ten hour discharge rage
30	Estimated life of cell under normal operating conditions (in years) % change in life of battery for change in ambient temperature 27 degree centigrade.
31	<ul style="list-style-type: none"> a. Maximum short circuit current per battery. b. Allowable duration of short circuit.
32	Short circuit current for a dead short across the Battery terminals when.
	<ul style="list-style-type: none"> a. Float at 2.1V per cell b. Boost charge to 2.75 V per cell.
33	Recommended floating voltage per cell and the Minimum variation.
34	Recommended interval at which battery should be Discharged at 10 hour rate and quick charged.
35	Recommended storage period of a fully charged battery.
36	Inter cell connector.
	<ul style="list-style-type: none"> a. Inter-cell connector furnished ? (Yes/No). b. Type of inter-cell connector (bolted or others)? c. Materials of inter cell connector.
37	Inter-row, inter tier connectors and end take- off furnished?

	Description. Size current rating type and material
38	Battery stack / rack.
	a. Outline dimensions. b. Type and material. c. Anti-acid coating type. d. Number of trays. e. Height of bottom tier from ground level. f. No. of cells which can be stacked in tray. g. Dimensions of each tray.
39	Total shipping weight of battery units.
40	A dimensional layout drawing of the battery stock / rack along with battery attached with the tender (yes /No)
41	The following characteristic curves to be furnished along with the tender (yes/No).
	a. Battery discharge curves at various rates between 1 minute and 10 hour rate. b. Curves showing the relation between the cell voltage and charging current, when charged at:
	14. Finishing rate. (ii) High starting rate. (iii) Two step charging by starting and finishing rate.

PART – B

CHARGER FOR PLANTE BATTERIES

BRIEF DESCRIPTION:

Charging equipment comprising of a **float charger and a Float cum boost & Float Cum Boost Charger suitable for 220 V Battery Type Lead acid Plante for Telecommunication Purpose** charger, is required to meet the D.C. power requirements of the sub-station under normal conditions, i.e., when AC auxiliary power supply is available and also to keep all the cells in the state of full charge. The float charger shall supply the continuous DC load at the bus bars in addition to keeping, the plante batteries floated in a healthy condition. In case of failure of A.C. mains or sudden requirement of additional DC power, the battery shall meet the demand as the battery shall be connected in parallel with the charger. After the battery has discharged to a considerable extent, it shall be fully recharged by the ‘boost’ charger unit in a short period so as to prepare it for the next emergency. Even during the ‘boost’ charging of the battery, the continuous DC load at the bus shall be met by the trickle-charging unit. The ‘boost’ charging unit shall however be provided with suitable control arrangement to function as a stand-by for float charging unit in case of necessity. SCADA Enabled Charger shall be provided.

ARRANGEMENTS :

Trickle (Float) Charger :

The trickle charger shall have arrangement for regulation of D.C. output voltage by:-

- (i) Automatic voltage regulation system.
- (ii) Shall be of thyristor control type with both ‘auto/manual’ control arrangement.

Quick (Boost) Charger:

The quick charger shall be similar type as trickle charging equipment, but shall have the following features.

- (i) Shall be of higher capacity to deliver D.C. output, as stipulated in this specification for quick charging of the plante batteries.
- (ii) Shall be provided with control arrangement for ‘auto/manual’ current regulation features, necessary for quick charging
- (iii) Shall also have ‘auto/manual’ voltage control arrangement for use when the charger will be utilized as a trickle charger.

The ‘Trickle’ and ‘Quick’ charger shall be self-supporting cubicle type with front panels hinged and suitable for mounting instruments, incoming A.C., circuit breaker with thermal and instantaneous releases relays, contactors and control switches etc. The panels shall have access from the backside also. These cubicles shall also house transformers, rectifiers and other

equipment's, accessories, as stipulated in this specification.

DESIGN AND CONSTRUCTION DETAILS:

The 'trickle' charger and 'quick' charger shall be complete with silicon controlled rectifier units, dry type air-cooled transformers, control electronics, smoothing filters etc. suitable for operation from $415V \pm 10\%$, $50\text{ HZ} \pm 5\%$, 3 phase A.C. supply. The charger output shall be stabilized to $\pm 1\%$ of set value for $\pm 10\%$ input voltage variations and 0-100% load variation.

The battery charger shall have full-wave, Half-controlled thyristor controlled bridge rectifier circuit. The charger output voltage shall suit the battery offered. The float voltage shall be adjustable from 80% to 115% of nominal voltage. The boost voltage shall be adjustable from 80% to 135% of nominal voltage. Ripple voltage shall be less than 3% RMS voltage.

Each float charger shall be capable of floating each cell of the battery bank at the specified voltage and supplying specified float current continuously under normal system operation.

Under normal operation, the float charger shall be supplying the DC load current and at the same time trickle charge the station battery. When the battery voltage goes down considerably, automatic transfer arrangement shall be provided such that the battery is disconnected from the float charger and gets connected to the boost charger. However, when battery is on boost charge, DC load shall be fed from the float charger. In addition, means shall be provided to ensure interruption free availability of control power from the battery whenever there is a power failure irrespective of whether the battery is on boost charge or float charge.

The selection of electronic components shall be used on ambient temperature of 50 degree C. and shall be of worst-case design to ensure continuous and trouble free service. The control electronics shall be built on plug in type glass epoxy printed circuit boards of modular design.

The maximum temperature, attained by any part of trickle charger and quick charger, when in service at site under continuous full load conditions shall not exceed the permissible limits as fixed by relevant standards and as corrected to site condition.

Charger Panel :

Charger panels shall be rigid, self-supporting structures, completely assembled and totally enclosed cubicle type construction, made out of structural steel members with sheet steel coverings.

The enclosure of the charger shall be made of CRCA sheet steel of thickness not less than 2 mm for load bearing members, 1.6mm for door and non-load bearing members and 3 mm for gland plates. Panels shall be offered with base frame of 3.0 mm thick CRCA sheet, painted black all around, suitable for bolting/ welding/ grouting on to the foundation. Gaskets on doors and inter panel gaskets shall be of neoprene rubber.

The panel shall have hinged front and back doors with concealed type hinged locks and latches.

The panel shall have adequate cross –ventilation arrangement to avoid any undue rise in temperature.

All equipment's and wiring used in the panel shall be tropicalized dust proof and vermin-proof.

Power wiring for the chargers shall be done with 1.1KV grade, heavy duty, single core, stranded copper conductor PVC insulated cables or suitable sized PVC sleeved copper bus bars. Control wiring for the charger shall be done with 1.1 KV grade PVC insulated copper wires of cross section 2.5 sq. mm for all control connection. Wire of 2.5 sq. mm cross section shall be used for control bus. All control wiring shall be ferruled.

Necessary terminals for grounding the panel with two separate earthings shall be arranged for bottom entry and suitable cable glands shall be provided for the cables.

Each charger panel shall incorporate all the necessary controls, Indications, interlocks, protective devices and timing features to ensure any operation.

Provision shall be made with necessary contact / relays for annunciation in the event of alternating current power failures to the charger and automatic shutdown of the charger by over-voltage / current devices. Annunciation shall however be prevented when the charger is manually shutdown or when A.C. power supply is momentarily interrupted for adjustable period of 1 to 5 seconds.

The float and equaliser charging rates shall both be adjustable from the front of the charger control panel. Each charger shall be protected against any damage from over voltage/ load currents and shall be so designed that it can continuously deliver at least rated current output without operation of the protective over-load device for abnormal conditions of low battery voltage down to 175V (80%) of the rated voltage). But the chargers shall be disconnected from A.C. input supply through an over-voltage relay, if the input voltage exceeds 10% of the rated voltage of the equipment. Necessary selector switches for 'Trickle Charging' and 'Quick charging' shall be provided. There shall be 'make before break' type blocking Diodes and other equipment to be shown in the drawing or otherwise found necessary for charging or otherwise found necessary for charging the battery without increasing the voltage beyond safe value across the load shall also be supplied by the tenderer.

The rectifier units of the chargers shall be capable of supplying an impulse load of 6/7 times its rated capacity. The trickle charger in conjunction with automatic voltage regulators shall have drooping characteristics, So as to transfer the load beyond its capacity to the battery.

The incoming and outgoing circuits shall be provided with MCCBs with static releases for overload, short circuit and earth fault protections. The incoming power supply to the chargers will be from two sources with a facility of changeover switch. The changeover facility shall be provided in the charger itself.

The battery circuit shall be provided with HRC fuse protection over a suitably rated load break isolator switch and reverse protection circuits.

Input volt meter and ammeter shall be of moving iron type and shall be 96 x 96 mm. Square. These meters shall be of accuracy class not less than 1.0 and shall be of flush mounting

type with required PTs and CTs and selector switches. Output voltmeter and ammeter shall be moving iron type and shall be 96 x 96 mm square. The meter shall be of accuracy class not less than 1.0 and shall be flush mounting type. The ammeter shall be center zero type for measurement of charging and discharging current from the battery.

Cluster LED lamps for indicating 'Input on' condition and 'Output on' condition, float status on / off, boost status on / off etc. shall be provided. Annunciation with audiovisual alarms shall be provided for the following.

- Input mains failure.
- Input phase failure.
- Input fuse failure.
- Rectifier fuse failure.
- Filter fuse failure
- DC over voltage
- DC under voltage
- Output fuse failure
- Charger over-load
- Earth leakage
- Alarm supply fuse failure
- Charger trip
- Output MCCB tripped
- AC under voltage
- Battery low condition

ACCEPT, TEST AND RESET push buttons shall be provided. 20% spare annunciation windows shall be provided.

Any other item(s), not stipulated in this specification, but required for installation, operation and maintenance of the battery charger is / are included in the scope of supply without any extra charge on OPTCL.

TRANSPORT: The chargers along with its accessories shall be suitably packed and transported to site in ready to use condition.

TESTS

Type Tests: The bidder shall submit the test reports along with his offer for the following type tests conducted on the offered samples (both float charger and boost charger) as per relevant National Standard (s) and test-witnessed by any Government Department /Government undertaking, failing which the offer is liable for rejection.

- (a) Measurement of voltage regulation / AVR regulation
- (b) Efficiency and power factor measurement test
- (c) Temperature rises test so as to determine the temperature rise of SCR, Transformer primary, Secondary and core, Diode, capacitor, choke and cabinet etc.
- (d) Measurement of insulation resistance.
 - i) AC input to earth.
 - ii) AC input to DC output.
 - iii) DC output to earth
- (e) Test for rectifier transformer.
- (f) DC voltage current characteristic
- (g) High Voltage Tests.
- (h) Determination of regulation
- (i) Measurement of ripple
- (j) Reverse leakage test.

Acceptance Tests : Followings shall constitute the acceptance tests which shall be tested by the purchaser's representative at the works of the manufacturer at the cost of the supplier (both for FC & FCBC) for each charger. No sampling is allowed.

- (a) Measurement of voltage regulation / AVR Regulation
- (b) Efficiency and power factor measurement
- (c) Temperature rise test so as to determine the temperature rise of SCR, Transformer primary, secondary and core, diode, capacitor, choke and cabinet etc.
- (d) Measurement of insulation resistance.
- (e) AC input to earth
- (f) AC input to DC output
- (g) DC output to earth
- (h) Test for rectifier transformer (all relevant tests as per corresponding ISS)
- (i) DC voltage current characteristic
- (j) High voltage tests.
- (k) Determination of regulation.
- (l) Measurement of ripple
- (m) Tests for indications and alarms as per this specification
- (n) Tests for indicating instruments.
- (o) Determination of system set points.
- (p) Soft start test

N.B.: The supplier shall provide arrangements for monitoring the temperature across the elements, as stipulated above, continuously during the temperature rise test without

disconnection of any of the temperature measuring devices across the hottest spot of each of the above elements.

All other tests, as may be necessary to ensure that all equipment's are satisfactory shall also be carried out. In addition to the above tests, manufacturer's test certificates, vendor's test certificates for different equipment's, accessories, instruments etc. shall be submitted, whenever required by the purchaser.

DRAWINGS / DOCUMENTS:

The tenderer shall submit the following drawings / documents along with his offer failing which the offer is liable for rejection.

- (a) OGA of the battery chargers
- (b) General layout with overall dimensions
- (c) Electrical schematic diagram showing connections and controls.
- (d) Leaflets and technical literature giving detailed information of the panels offered. The manufacturer shall submit the following drawings / documents in 7 (seven) copies within 15 (fifteen) days from the date of issue of the purchase order for purchaser's approval.
- (a) OGA of the battery chargers
- (b) General layout with overall dimensions marked along with sectional views showing cable entry position etc.
- (c) Rating calculations for transformer, rectifiers, diode, capacitor, inductor etc.
- (d) Detailed schematic and connection and control wiring diagram for all the equipment
- (e) Complete bill of materials
- (f) Technical excerpts on operation.
- (g) The circuit diagram of charger including circuit diagrams of all cards to facilitate the maintenance of chargers

SPECIAL TOOLS, PLANTS AND SPARES:

The tender shall quote for recommended special tools, plants and spares, considered necessary for installation and maintenance of batteries and charges for a minimum

period of 5 (five years.)

The following mandatory spares are to be quoted by the bidder in the price bid:-

- a) Voltage regulator cards- 1 No/Charger.
- b) Protection card (if any) - 1 No/ Charger.
- c) Thyristor (SCR) - 2 Nos. for F.C. + 2 Nos. for B.C. / Charger.
- d) Rectifier Diode- 2 Nos. for F.C, + 2 Nos. for B.,C./Charger.
- e) Blocking Diode- 1 No. for F.C. + 1 No. for B.C. / Charger.
- f) Filter Capacitor- 1 Set/Charger.
- g) Auto-manual switch- 1 No. for F. C. + 1 No. for B.C. / Charger.
- h) Indicating LED- 10 Nos./Charger
- i) Indicating fuse (if any)- 10 Nos./Charger
- j) Input A.C. contactor- 1 No. for F.C., + 1 No. for B.C./ Charger
- k) Rectifier H.R.C. fuses- 4 Nos. for F.C. + 4 Nos. for B.C./Charger.

GUARANTEED TECHNICAL PARTICULARS

The guaranteed technical particulars of this specification shall be furnished along with the tender. Any tender, lacking complete information in this respect is likely to be rejected.

DEVIATION FROM SPECIFICATION:

All deviations from the specification shall be separately listed in the technical deviation sheet, in the absence of which it will be presumed that the provisions of these specifications are complied with by the tenderer.

GENERAL TECHNICAL REQUIREMENTS FOR BATTERY CHARGER SUITABLE FOR 220 V LEAD ACID PLANTE BATTERY:

1	Type	Float & Float cum boost charger for 220 V DC full wave, full controlled type.
2.	RATINGS	>220V: 350 AH Plante Battery: 35A/60A Float & Float cum Boost Charger.
3.	AC INPUT (a) Voltage (b) Frequency (c) Phase	415VAC \pm 10% 50Hz \pm 5% 3-phase-4 wire

4.	D.C.OUTPUT VOLTAGE SETTINGS Nominal Float	FC 220V/48V 247.5V/54.5V <i>*The DC output voltage shall be adjustable from 200V to 250V</i>	BC 220V/48V 302V/66.5V <i>*The DC output voltage shall be adjustable from 220V to 302V</i>
5.	OUTPUT CURRENT LIMIT	35A	60A (for 350AH)
6.	POWER CONVERSION	AC to DC by means of three phase full wave, Half controlled bridge rectifier consisting of thyristors and diodes.	
7.	VOLTAGE REGULATION AT BRIDGE OUTPUT.	$\pm 1\%$ of set value for $\pm 10\%$ Input Voltage Variations, 0-100% Load variation.	
8.	RIPPLE VOLTAGE	Less than 3% RMS without battery connected.	
9.	EFFICIENCY	More than 75% at full load	
10.	PROTECTIONS		
	(a) Input side	AC input MCCB with input ON/OFF switch and fuses, contactor (for source-1&2 with interlocking)	
	(b) Output side	DC output MCCB with output ON/OFF switch and fuses contactor.	
	(c) Protection	Current limit protection, soft start feature, surge suppressor. Fast semiconductor fuses for rectifier bridge.	
	(d) control circuit	Fuses	
	(e) Capacitor circuit	Rectifier HRC fuses.	
	(f)	Over-voltage cut-back	
	(g)	Charger over load / short circuit	
	(h)	Blocking diode	
	(h)	Blocking diode	
11.	CONTROLS AND SWITCHES	Followings controls and switches are provided in the system a) AC input source MCCBs with interlocking b) DC output MCCB c) Auto/Manual float/boost mode selector switch. d) Float and boost voltage variable potentiometers. e) Manual voltage adjustment Potentiometer	

		<ul style="list-style-type: none"> f) Test push button g) Reset push button h) Battery current adjustment potentiometers i) Heater's power supply switch j) Socket power supply switch 		
12.	FEATURES	<p>The following features are provided in the systems:</p> <ul style="list-style-type: none"> a) Soft start on DC side b) Class-F insulation for all magnetic c) Automatic voltage regulation. d) Automatic changeover from float to boost and vice versa based on current, drawn by battery. e) Filter circuit to eliminate ripple. f) Charger current limit g) Separate battery path current limit. h) Built-in auto phase reversal of operation. 		
13.	Meters	<table border="1" style="width: 100%;"> <tr> <td style="width: 50%; vertical-align: top;"> <p><u>F.C.</u></p> <ul style="list-style-type: none"> (i) Input Voltmeter (ii) Input Ammeter (iii) Output Voltmeter (iv) Output Ammeter </td> <td style="width: 50%; vertical-align: top;"> <p><u>B.C.</u></p> <ul style="list-style-type: none"> (i) Common (ii) Input Ammeter (iii) Output Voltmeter (iv) Output Ammeter </td> </tr> </table>	<p><u>F.C.</u></p> <ul style="list-style-type: none"> (i) Input Voltmeter (ii) Input Ammeter (iii) Output Voltmeter (iv) Output Ammeter 	<p><u>B.C.</u></p> <ul style="list-style-type: none"> (i) Common (ii) Input Ammeter (iii) Output Voltmeter (iv) Output Ammeter
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		<p>Battery volt meter Battery ammeter Earth leakage ammeter</p>		
14.	Indications	<table border="1" style="width: 100%;"> <tr> <td style="width: 50%; vertical-align: top;"> <ul style="list-style-type: none"> (i) R,Y,B Phase 'ON' lamps (ii) Output 'ON' lamp </td> <td style="width: 50%; vertical-align: top;"> <ul style="list-style-type: none"> (i) R.Y.B. phase 'ON' lamps (ii) Output 'ON' lamp. (iii) Charger 'ON' floatLED (iv) Charger 'ON' boostLED. </td> </tr> </table>	<ul style="list-style-type: none"> (i) R,Y,B Phase 'ON' lamps (ii) Output 'ON' lamp 	<ul style="list-style-type: none"> (i) R.Y.B. phase 'ON' lamps (ii) Output 'ON' lamp. (iii) Charger 'ON' floatLED (iv) Charger 'ON' boostLED.
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15.	Annunciation with audiovisual alarms.	<table border="1" style="width: 100%;"> <tr> <td style="width: 50%; vertical-align: top;"> <ul style="list-style-type: none"> (i) AC input mains failure (ii) Input phase failure (iii) AC under voltage (iv) Input phase failure (iii) Rectifier fuse failure (iv) Output fuse failure (v) Filter fuse failure (vi) DC under voltage (vii) DC over voltage (viii) Charger trip (ix) Capacitor fuse fail (x) Output MCCB tripped (xi) Charger over load (xii) Earth leakage (xiii) DC earth fault (xiv) Alarm supply failure (xiii) Battery condition. </td> <td style="width: 50%; vertical-align: top;"> <ul style="list-style-type: none"> v) Rectifier fuse failure vi) Output fuse failure vii) Filter fuse failure viii) DC under voltage ix) DC over Voltage x) Charger trip xi) Capacitor fuse fail xii) Output MCCB tripped. </td> </tr> </table>	<ul style="list-style-type: none"> (i) AC input mains failure (ii) Input phase failure (iii) AC under voltage (iv) Input phase failure (iii) Rectifier fuse failure (iv) Output fuse failure (v) Filter fuse failure (vi) DC under voltage (vii) DC over voltage (viii) Charger trip (ix) Capacitor fuse fail (x) Output MCCB tripped (xi) Charger over load (xii) Earth leakage (xiii) DC earth fault (xiv) Alarm supply failure (xiii) Battery condition. 	<ul style="list-style-type: none"> v) Rectifier fuse failure vi) Output fuse failure vii) Filter fuse failure viii) DC under voltage ix) DC over Voltage x) Charger trip xi) Capacitor fuse fail xii) Output MCCB tripped.
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Note: All the alarms shall be provided through electronic display cards. Audio alarm through buzzer, visual indication through 10 mm LEDS & alarm ackn. / reset and LED provision is through push buttons.

16.	Operating ambient temperature surrounding the panel	0° to 50°C
17.	Surrounding the panel Relative humidity.	0-95% non-condensing
18.	<u>PANEL</u> (a) Protective grade (b) Cooling (c) Paint	(a) IP – 42 (b) Natural air-cooled (c) Smoke Grey of ISS-692 shade
19.	<u>MAGNETICS:</u> (a) Average winding temperature rise over ambient temperature (b) Insulation class (c) Insulation Breakdown voltage.	As per relevant ISS. ‘F’ 3kV for 1 min withstand.
20.	<u>CABLES</u>	1100 V grade PVC insulated copper. Ferrules shall be provided for identification of connection.

N.B.: - Besides the above general technical requirements, all other stipulations, as enumerated in this technical specification shall be followed. Any deviation should be clearly brought out with clear explanation.

Any extra feature/ equipment / instrument as necessary for operation and performance of the battery charger for the 220V battery set as per this specification shall be provided without any extra cost to OPTCL.

ANNEXURE – IV-A

(For Testing of Battery) (To be filled in by the bidder)

CALIBRATION STATUS OF TESTING EQUIPMENTS AND INSTRUMENTS/ METERS

Name of the Test	Meters & Equipments required for the corresponding test with range, accuracy, make & Sl.No.	Date of Calibration	Due date of Calibration	Name of the Calibrating Agency	Whether Calibrating Agency is Govt. approved	Whether documents relating to Govt. approval of the calibrating Agency furnished	Whether the meters/equipments fulfil the accuracy class as per calibration report.	Whether the calibrating agency has put any limitation towards the use of the particular meter/equipment. If yes, state the limitations	Whether the calibrating agency has put any limitation towards the use of the particular meter/equipment. State the colour of the affixed sticker	In spite of imposed limitations. Whether the particular meter / equipment can still be used ? Justify its use for corresponding test(s)	Remarks
1	2	3	4	5	6	7	8	9	10	11	12

Signature of the tenderer with seal & date

ANNEXURE – IV-B

(For Testing of Battery Charger) (To be filled in by the bidder)

**CALIBRATION STATUS OF TESTING EQUIPMENTS AND INSTRUMENTS/
METERS**

Name of the Test	Meters & Equipments required for the corresponding test with range, accuracy, make & Sl. No.	Date of Calibration	Due date of Calibration	Name of the Calibrating Agency	Whether Calibrating Agency is Govt. approved	Whether documents relating to Govt. approval of the calibrating Agency furnished	Whether the meters/ equipments fulfil the accuracy class as per calibration report.	Whether the calibrating agency has put any limitation towards the use of the particular meter/ equipment. If yes state the limitations	Whether the calibrating agency has put any limitation towards the use of the particular meter/equipment/ meter. State the colour of the affixed sticker	In spite of imposed limitations. Whether the particular meter / equipment can still be used ? Justify its use for corresponding test(s)	Remarks
1	2	3	4	5	6	7	8	9	10	11	12

Signature of the tenderer with seal & date

ANNEXURE V – A
(To be filled in by the bidder)
CHECK LIST TOWARDS TYPE TEST
REPORTS FOR BATTERY

Name of the Type Test	Date of Test	Name of the Laboratory where the Test has been conducted	Whether the Laboratory is Government approved	Whether the Test report is valid as per Spn.	Whether the Test report is complete in shape along with drawings etc. furnished or not ?	Whether the type tested Plant lead acid battery fulfills the technical requirements as per TS	If the type tested battery does not fulfill the technical requirements as per this specification, whether the bidder agrees to conduct the particular type test again at their own cost without any financial liability to OPTCL in the presence of OPTCL's representative within the specified delivery period	Remarks
1	2	3	4	5	6	7	8	9

Signature of the tenderer with seal & date

ANNEXURE V – B
(To be filled in by the bidder)
CHECK LIST TOWARDS TYPE TEST
REPORTS FOR BATTERY CHARGER

Name of the Type Test	Date of Test	Name of the Laboratory where the Test has been conducted	Whether the Laboratory is Government approved	Whether the Test report is valid as per Spn.	Whether the Test report in complete shape along with drawings etc. furnished or not?	Whether the type tested battery charger fulfills the technical requirements as per TS	If the type tested battery charger does not fulfill the technical requirements as per this specification, whether the bidder agrees to conduct the particular type test again at their own cost without any financial liability to OPTCL in the presence of OPTCL's representative within the specified delivery period	Remarks
1	2	3	4	5	6	7	8	9

Signature of the tenderer with seal

PART-22
48V BATTERY & BATTERY CHARGER

TECHNICAL SPECIFICATION FOR 48 VOLT MF-VRLA STORAGE BATTERY CHARGER FOR 48V DC SYSTEM

1. SCOPE:

- 1.1 This specification covers the design, manufacture, assembly, shop testing at manufacturer’s works before dispatch, supply and delivery at site, erection, testing and commissioning of 48 volt 300AH (24 cells) MF- VRLA storage batteries along with the required accessories and fittings etc.
- 1.2 It is the intention of the purchaser to install the most up to date type of equipment conforming to modern practices.
- 1.3 **The scope of supply shall include all parts and accessories etc, which are usual and necessary for erection, operation and maintenance of MF-VRLA batteries as specified, though not individually and specifically stated or enumerated.**

2. SITE CONDITIONS:

The material to be supplied against this specification shall be suitable for satisfactory continuous operation under the following Topographical and Meteorological conditions.

S.NO	PARTICULARS	CONDITION
1	Maximum ambient air temperature	50deg C
2	Minimum ambient air temperature	5deg C
3	Average ambient air temperature	32 deg C
4	Maximum Relative Humidity	100%
5	Maximum altitude above mean sea level	Below 1000m
6	Maximum wind speed	50 m/s
7	Isokeraunic level	70 Days/year
8	Seismic level	Zone-3

3. CODES AND STANDARDS:

All equipment and their accessories, covered by this specification shall be designed, manufactured and tested in compliance with the latest relevant standards, published by the Bureau of Indian Standards including those, listed at Clause 2.6 in order that specific aspects under Indian climatic conditions are taken care of.

The equipment and accessories for which Indian Standards are not available shall be designed, manufactured and tested in accordance with the latest standards, published by any other recognized National Standards Institution and latest publication of International Electro Technical commission [IEC].

The equipment manufactured according to any other authoritative national / international standard, which ensures an equal or better quality than the provisions of these specifications shall also be acceptable. Where the equipment, offered conform to any other standard, salient points of differences between the proposed standard and the provisions of these specification shall be clearly brought out in the tender. A copy of such standards [in English] shall be enclosed with the offer.

The equipment shall conform to the Indian Electricity Rules, 1956 with latest amendments as regards safety earthing and other essential provisions specified therein for installation and operation of electrical plants.

GOVERNING SPECIFICATION:-

The MF-VRLA batteries shall unless otherwise specified, conform to the following standards. The firms are requested to furnish the following specifications for our further reference.

i	IS-1651/1991	Specification for stationary cells
ii	IS-1885 [Part-8] / 1986	Electro technical vocabulary: Part- 8- Secondary cells & batteries.
iii	IS-266/1977	Sulphuric acid
Iv	BS-46290 (Part-4) / 1997	British standard specification for lead acid type valve regulated sealed type
v	ANSI, IEEE STD 450/1987	IEEE recommended practice for maintenance, testing and replacement of large lead storage batteries for
vi	IEC 896-2/1995	Stationary lead-acid batteries, general requirements and methods of test (part-
vii	IS-(1146 / UI-94) / ASTM - d - 29863	Plastic container for lead acid storage batteries.
viii	IS-3136-1965	Specification for polycrystalline semiconductor rectifier equipment
ix	IS-1248-1968	Specification for direct acting indicating analogue electrical measuring instruments and tier accessories. (Part - I)-1983-General Requirements. (Part - II)- 1983 - Ammeters &
x	IS-2208-1962	Specification of HRC Cartridge fuse link
xi	IS-2959-1966	Specification of contractors for voltages not exceeding 1000V AC or 1200V DC
xii	IS-3395-1966	Specification for monocrystalline semiconductor rectified cells and
xiii	IS-4540-1968	Monocrystalline semiconductor rectifier assemblies & equipment

xiv	IS-2147/1962	Degree of protection provided by enclosure for low voltage switchgear
xv	IS-5578/1984	Guide for marking of insulated
xvi	IS-8623/1993 [Part 1 to 3]	Low voltage switchgear and control gear
xvii	IS-11171/1985	Dry type power transformers.
xviii	IS-11353-1985	Guide for uniform system of marking and identification of conductors and
xix	IS-13947-1993 (Part 1 to 5)	Low voltage switchgear and control gear

OTHER REQUIREMENTS:-

ACCESSIBILITY AND INTER CHANGEABILITY:

BATTERY: Easy installation and handling and easy cell replacement. Batteries should be compact and can be used in any orientation without any leakage or spillage of electrolyte

QUALITY AND WORKMANSHIP:

Workmanship and materials shall be of good commercial quality, suitable for the purpose, intended and in accordance with the highest standards and practices for equipment of the class, covered by this specification.

SAFETY:

All equipment shall be complete with approved safety devices wherever a potential hazard to personnel exists and with provision for safe access of personnel to and around the equipment for operational and maintenance functions. The design shall include all necessary precautions and provisions for the safety of operating and maintenance personnel.

There should be no emission of corrosive fumes or gases under normal operating condition in case of Battery.

Special care shall be taken to make enclosed equipment proof against entry of rat, lizards and other creeping reptiles, which may create electrical short circuits inside, live equipment.

Continuity of power supply is the first consideration and the design shall be such as to provide facilities to simplify inspection, testing maintenance, clearing and repair at site.

SPECIAL SITE CONDITIONS:-

The equipment with their accessories shall be designed for smooth, efficient and trouble free operation in tropical humid climate for maximum temperature of 50 degree C and maximum humidity of 98 percent. Maximum temperature and maximum humidity are

however not likely to occur simultaneously. De-rating of equipment shall be done for an ambient temperature of 50 degree C.

PAINTING:-

All items of equipment and materials shall be thoroughly cleaned and painted in accordance with IS Specification.

CONSTRUCTIONAL DETAILS OF MF- VRLA BATTERY:

PLATES:

Positive plates shall be made of flat pasted type using Lead-calcium-tin alloy for durability, low corrosion, maintenance free, low self-discharge rates and long life both in cyclic as well as in the float applications.

Negative plates shall be heavy duty, durable flat plate using lead-calcium-tin alloy grid. Negative plates shall be designed to match the life of positive plates and combination of positive and negative plates shall ensure long life, durability and trouble free operation of the battery. PLC Operated equipment should be deployed for preparation of plate to ensure consistency in plate quality. Conventional / manual type of plate preparation is not allowed.

SEPARATORS:-

The separator shall be absorptive glass mat type or spun glass micro porous matrix type and shall be resistant to sulphuric acid. It shall be capable of keeping all the electrolyte and shall be electrically insulated. Sufficient separator overlap and PVC shield protection to top and bottom edges of the plates is to be provided to prevent short circuit formation between the edges of adjacent plates. The uncompressed water absorption of the separator shall be at least 5 gm. of water / gm of separator material.

REQUIREMENT OF WICKING TEST ON SEPARATORS:-

The total wicking height shall not be less than 635 mm in 24 hours. The minimum water content at 125 mm. Height shall be at least 5 gm. of water per gm. of separator. The weight of water per gm. shall be at least 90% of the value at 125 mm when checked at a height of 450 mm.

VALVE:-

Safety valve vent plugs shall be provided in each cell. They shall be explosion resistant, self-resealing and pressure regulating type. They shall not allow gas (air) to enter into the cell but shall allow gas to escape from the cell above a certain internal pressure, which does not lead to deformation or other damage to the cell.

The vent plug used shall be explosion resistant and self re-sealing pressure regulating type. Vent plug shall be such that it cannot be opened without proper tool.

The valve shall be so designed that it operates at a pressure between 0.14 Kg / Sq. mm to 0.63 Kg / Sq. mm to release the excess gas and reseal automatically as soon as the gas pressure within the cell drops to atmospheric value.

All the cells shall be subjected to pressure test upto 0.7 Kg / Sq. mm.

The self-discharge rate at room temperature shall not be more than 5 % of the capacity of each battery per month.

Each valve opening shall be covered with flame barrier capable in preventing the ingress of flame into the cell interior when the valve opens and hydrogen / oxygen gas mixture is released.

CONTAINERS AND LID:-

The container shall be made up of a special grade polypropylene copolymer material, which should be of flame-retardant.

The container shall be sufficiently robust and not liable to deformation under internal operating pressures and within the temperature range, naturally encountered, leak proof, non-absorbent and resistant to the acid with low water vapor permeability.

The container shall be enclosed in epoxy coated steel trays. The steel trays shall be so designed as to make both vertical and horizontal stacking of cells / batteries possible.

LIDS / COVERS:

Sealed maintenance free batteries shall have polypropylene copolymer covers. The complete container along-with lid / cover shall be able to withstand without fracture for 5 hours at 25 degree Celsius at an internal pressure of 5 times the normal operating pressure. The complete design includes the pillar to lid seal, which shall be designed to remain gas-tight and electrolyte-tight during the designated life of the battery.

PILLAR SEAL ASSEMBLY:-

The pillar to lid seal shall be designed to remain gas-tight and electrolyte-tight during the designated life of the unit. The terminal shall conform to Class 3.2 of BS: 6290, Part - 4 - 1987.

ELECTROLYTE:-

The electrolyte shall be prepared from the battery grade H₂SO₄ conforming to ISS: 266. The batteries shall be supplied in factory filled charged condition. All the acid will be in immobilized condition the AGM separator.

WATER:-

Water required for preparation of electrolyte shall conform to IS: 1069.

CONNECTORS AND FASTENERS:-

Lead or lead coated copper connectors shall be used for connecting up adjacent cells and rows. The thickness of lead coating of connectors should be not less than 0.025 mm. The lead coating thickness shall be measured in accordance with APPENDIX-F of IS: 6848: 1979. All the terminals and cells inter connectors shall be fully insulated or have insulation shrouds. End take off connections from positive and negative and poles of batteries shall be made by single core cable having stranded aluminum / copper conductors and PVC / XLPE insulation. Necessary supports and lugs for termination of these cables on batteries shall also be supplied by the supplier. All connectors and lugs shall be capable of continuously carrying the 30 minute discharge current of the respective batteries and through fault short circuit current which the battery can produce and withstand for the period declared. Bidder shall furnish necessary sizing calculations to prove compliance to the same.

PLATE CONNECTIONS:

Lugs of plates of like polarity shall be connected by lead burning to a horizontal strap having an upstanding terminal post adopted for connection to external circuit. Strap and post shall be casted with lead alloy. The positive and negative terminal posts shall be clearly marked for unmistakable identification.

NUT & BOLTS:

Nuts and bolts for connecting the cells shall be made of copper, brass or superior grade passivated stainless steel which should be resistant to sulphuric acid. Copper & brass shall be coated / plated with suitable materials such as Nickel / Chromium to prevent sulphation or corrosion.

TERMINALS:-

Terminals shall be of integral lead terminal with solid copper core with M6 threading for fastening. The junction between terminals posts and cover and between the cover and container shall be hermetically sealed.

SEAL:-

- a) TIG welding shall be done for post sealing.
- b) Additional Epoxy resin sealing shall be provided for double assurance against leakage.

SUPPORTING RACKS:-

Batteries shall be installed on MS racks **to be supplied by the supplier** to fit in the battery /battery charger room. Racks / trays shall be powder coated with anticorrosive paint and supplied in unassembled state. Rack / tray shall be subjected to 7 tank processes before painting for protection against fungus growth and other harmful effect due to tropical environment.

The steel trays / containers shall be stackable one over the other horizontally in multi-tier arrangement. The bottom most tray shall be mounted on I-channels with 150 mm height. The positive and negative terminals shall be terminated onto the terminal plate assembly, which is fitted to one of the steel tray depending on the convenience at site.

MARKING:-

The following information shall be legibly laid durably marked on each cell battery:-

- (a) Nominal Voltage.
- (b) Name of the manufacturer and type reference.
- (c) Rated or nominal capacity expressed in ampere hour (AH) with an indication of the rating expressed either as a current or as time together with the relevant final voltage of each cell.
- (d) Voltage for float operation 270 C with tolerance of 1%.
- (e) Cell number.
- (f) Type of positive plate.
- (g) Type of container.
- (h) Date of manufacture (month and year) or (week and year).

MAXIMUM SHORT CIRCUIT CURRENT:-

The bidder shall state the maximum short circuit current of each battery along-with the safe duration in seconds, which it can withstand. Complying with clause 5.5 of IEC – 896 – 2/1995. Method proposed to be adopted for protecting batteries from the short circuit conditions should also be stated to avoid damage to the battery and loss to the associated equipment.

VENTILATION:

The Bidder shall indicate in his bid the requirements of ventilation in the battery room. The battery shall operate satisfactory over the entire range of temperature indicated in this specification without affecting its normal life. Bidder shall indicate the percentage reduction in battery capacity at the lowest temperature of 27 Degree C. If any special ventilation requirements are necessary, the same shall be indicated.

CAPACITY:

The standard Ampere-hour capacity at ten hour rate shall be 300 AH to end cell voltage of 1.75 volts /cells as per IS 15549/2005.

SELF DISCHARGE RATE OF BATTERY:

Self-discharge rate shall be less than 0.5 % of C 10 Capacity per week at 27 degree C.

CHARGING:-

The bidder shall state whether an equalizing charge is recommended for the battery. If so, the equalizing charge voltage, current, duration and the interval between the equalizing charging shall be specified in the Data Sheet. Bidder shall also indicate the requirements for boost charging.

LIFE:-

The bidder shall quote in his offer the guaranteed life of the battery, when operating under the conditions, specified. The bidder shall also quote the change in life of the battery due to change in temperature from 27 degree centigrade in the event the batteries are required to be operated under higher temperature environment.

DESIGN VALIDATION:-

Over the range of manufacturer's capacity, at least one capacity should have been tested and should meet the requirement of Service Life as per ANSI TI: 330 Specification. Necessary evidences maybe enclosed along-with the offer.

MAINTENANCE TOOLS & INSTRUCTION:-

Two sets of operation & maintenance manuals along with each set of battery shall have to be furnished.

It is mandatory for the bidder to provide with the spare relating to the batteries including cells for replacement for a minimum period of 8 years.

ELECTRICAL CHARACTERISTICS:-

DESIGN SHOULD ENSURE THAT:-

- (a) Battery shall be suitable for constant current constant voltage charging.
- (b) Nominal float voltage shall not exceed 2.25 V per cell @ 27 degree C.
- (c) Recharging shall be done at normal float voltage.
- (d) Charging current shall not exceed 0.15 C. Where C is the capacity in AH @ 10 hours of discharge to end cell voltage 1.80 V @ 27 0C.
- (e) Except during commissioning. Battery shall not demand boost charging at any point of time during its operation.
- (f) Battery shall not demand equalizing charge at any point of time during its operation.

PROCESS REQUIREMENT:-

- (a) 100% cells shall be tested by Helium ion leak tester for leak free performance. Vendor shall attach a copy of the Helium ion tester report along with the dispatch documents.
- (b) Vendor is expected to monitor the voltage and current data of the cells during initial charge and test discharge by means of automatic data logging for traceability. Vendor shall maintain the database of the same and provide the document to the company as and when called for.

TESTS:

TYPE TESTS:-

The bidder shall submit the test reports along with his offer for the following type tests, conducted on the offered samples as per relevant National Standard (s) test witnessed by any Government Department / Government undertaking failing which the offer is liable for rejection.

- (a) Verification of constructional requirements.
- (b) Verification of dimensions /weight.
- (c) Test for capacity.
- (d) Test for charge retention.
- (e) Endurance test.
- (f) Ampere-hour and watt-hour efficiency test.
- (g) Test for voltage during discharge.
- (h) Test for endurance under short circuit conditions.
- (i) Test for gas recombination efficiency.
- (j) Wicking test Separators.
- (k) Service Life test as per ANSI TI: 330 Specification.

If the type test report (s) does / do not meet the requirements as per this specification. OPTCL at its discretion may ask the supplier to conduct the above type test (s) at the supplier's cost in the presence of OPTCL's representative without any financial liability to OPTCL.

ROUTINE TESTS:-

All the routine tests, listed below shall be carried out on all the cells, containers. Hardware being supplied as per latest issue of BS: 6290, Part –4. IE C89-I or IEEE – 1188 (whichever is applicable) at the cost of the supplier.

(a) Container

- (i) Verification of constructional requirements.
- (ii) Verification of marking and packing.
- (iii) High voltage tests (CI: 7.6 of IS: 1146).

(b) Cells and batteries:-

- (i) Verification of constructional requirements.
- (ii) Verification of markings.
- (iii) Verification of dimensions.

ACCEPTANCE TESTS:-

Followings shall constitute the acceptance tests which shall be test-witnessed by Purchaser's representative at the works of the manufacturer at the cost of the supplier.

1. Verification of dimensions.
2. Verification of marking.
3. Tests for capacities for 10 hours discharge rate along with the test for voltage during discharge.
4. Ampere-hour and watt-hour efficiency test.
5. Short circuit current test of batteries (arrangement for this shall be provided during testing).
6. Resistance of cell / batteries.
7. Pressure of vent plug connected with battery (measuring shall be provided during testing).
8. Measurement of weight / material type and dimension of cell / racks / Batteries and all other accessories as per approval of drawings / technical data submitted during tender process. All these shall be submitted in detail with the submission of tender paper.

The purchaser may at his discretion undertake test for capacity and voltage during discharge after installation of the battery at site without any extra cost.

The supplier shall arrange for all necessary equipments, including the variable resistor, tools, tackles and instruments. If a battery / battery charger fails to meet the guaranteed requirements, OPTCL shall have the option of asking the supplier to replace the same.

DRAWINGS / DOCUMENTS:-

The tenderer shall submit the following drawings documents along with his offer failing which the offer is liable for rejection.

- (a) General battery arrangement including proposed size of individual and over all dimensions along with sectional views showing all connections etc.
- (b) Pamphlets and technical literature giving detailed information of the batteries offered.

The manufacturer shall submit the following drawings / documents in duplicate within (fifteen) days from the date of issue of the purchase order for purchaser's approval.

- (a) Layout details of the batteries with all accessories.
- (b) OGA Cross-sectional details for battery cells.
- (c) Instruction manuals for initial charging and subsequent charging.
- (d) Technical data, characteristic curves etc.

TRANSPORT:-

The charged batteries, accessories and racks shall be suitably packed and transported to site in ready to use condition.

All deviations from the specification shall be separately listed, in the absence of which it will be presumed that the provisions of these specifications are complied with by the bidder.

ANNEXURE –I:

SPECIFICATION FOR 48 Volt 300AH MF-VRLA BATTERY

To be filled in by the bidder

SL. NO.	SPECIFICATION	CONFIRM / NOT CONFIRM
1	Maintenance free valve regulated sealed type Lead acid battery 48Volt 300AH. 2V per cell [Total 24 Nos. battery cells/set]	
2	The cells should be assembled in stack overinsulated steel rack to make 48 Volt / 300AH battery set for communication system.	
3	The steel rack will be placed over porcelain. Hard rubber insulator of 100 mm Height [approx.] to minimize leakage current to ground	
4	All the battery cells are to be assigned with number	
5	The final positive and negative terminals are to be brought to the terminal plate assembly (TPA). Suitable arrangement should be made for terminating the cables at the TPA	
6	Test for capacity of batteries should conform to IS: 15549/2005	
7	The battery should be supplied with all accessories like connectors, links, and S.S. nuts. Bolts and insulator etc.	
8	All the portion of connectors and adjacent steel plates are to be sleeved and insulated.	
9	Discharge test of batteries at 10 hr. rate of discharge to end cell voltage of 1.75 volt per cell to conform to the requirement of IS : 15549/2005 should be carried out by the supplier at the works of manufacturer and at the site. The ambient temperature at the place of installations will be considered for the calculation period of discharge.	

10	The battery should have a life expectancy of minimum 8 years at battery room ambient temperature that varies from a minimum of 20 degree centigrade during winter season and a maximum of 50 degree centigrade during peak summer. The tenderer should submit the relevant technical literature with details design, calculation graph documents etc. in support of indicated life of the battery taking care of the above seasonal ambient temperature variation.	
11	The supplier should submit the documentary evidence (P.O. copy) for supply, installation and commissioning of battery capacity of 300 AH or higher capacity to the communication Systems under any GRID Sub-stations/communication equipments and the same is in successful operation for a minimum period of last 2 years as on date of opening of the tender.	
12	The watt-hour and ampere-hour efficiency and internal resistance value of the battery should be furnished.	
13	The supplier should show the values of internal resistance of all the cells at the time of commissioning at site and the same should confirm to the value indicated by them in their technical bid.	
14	The procedure of charging the battery before the capacity test should be furnished. The battery set will be inspected & tested at works before dispatch to store/site.	

ANNEXURE II

**SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS FOR 48 VOLT
300 AH MF-VRLA LEAD ACID STORAGE BATTERY (TO BE FILLED IN
BY THE BIDDER)**

Values / Others.

Manufacturer's name and address :				
Conforming to standards.				
Type and designation as per IS.				
Manufacturer's type and designation				
Capacity of battery bank at the following discharge rates at 270	Ca	Rate of Disch. Current	End Cell voltage	
	p.			
	C			
	A			
	H			
<ul style="list-style-type: none"> a. 15 minutes. b. 30 minutes. c. 45 minutes. d. 1 hour e. 2 hours f. 3 hours. g. 4 hours. h. 5 hours. i. 6 hours. j. 7 hours. k. 8 hours. l. 9 hours. m. 10 hours. 				

	Number of cells in the battery.
7	Method of interconnection between cells.
8	Maximum short circuit current of battery when short circuit is at the end of terminals
9.	Recommended float-charging voltage across the battery terminals (volts).
10	Recommended boost charging voltage across battery terminals (volts).
11	Time required for boost charging from discharged conditions (in hours).
12	Recommended trickle / float charging rate
13	Recommended boost charging rate.
14	Trickle charging current range / cell.
15	Shelf life of charged battery bank.
16	Open circuit voltage of battery bank when fully charged.
17	AH capacity at 10 hours rate at room temperatures of:-
	<ul style="list-style-type: none"> a. 15°C. b. 27°C c. 50°C
18	Cell Particulars:-
	<ul style="list-style-type: none"> a. Material of container. b. Overall dimensions of each cell. c. Weight of cell complete with acid.
19	Voltage:-
	<ul style="list-style-type: none"> a. Open circuit voltage of cells. b. Float charging voltage. c. Boost charging voltage.
20	Type of material / thickness / dimension of positive plates.
21	Type of material / thickness / dimension of negative plates.
22	Separators:-

	<ul style="list-style-type: none"> a. Type. b. Materials. c. Thickness of separator.
23	Type of valve provided.
24	Internal resistance of each cell at
25.	Clearance in mm between.
	<ul style="list-style-type: none"> a. Top of plates and top of container. b. Bottom of plates and bottom of container.
	c. Edges of plates and inner surface of container.
26	Maximum ambient temperature that the cells can withstand. Without injurious effect.
	<ul style="list-style-type: none"> a. Continuously. b. Short periods (duration to be stated along with temperature).
27	Maximum number of charge / discharge cycles that the cell can withstand.
28	Ampere-hour efficiency at ten-hour discharge rate.
29	Watt-hour efficiency at ten hour discharge raga
30	Estimated life of cell under normal operating conditions (in years) % change in life of battery for change in ambient temperature 27 degreecentigrade.
31	<ul style="list-style-type: none"> a. Maximum short circuit current per battery. b. Allowable duration of short circuit.
32	Short circuit current for a dead short across the Battery terminals when.
	<ul style="list-style-type: none"> a. Float at 2.1V per cell b. Boost charge to 2.75 V per cell.
33	Recommended floating voltage per cell and the Minimum variation.
34	Recommended interval at which battery should be Discharged at 10 hourrate and quick charged.
35	Recommended storage period of a fully charged battery.
36	Inter cell connector.
	<ul style="list-style-type: none"> a. Inter-cell connector furnished ? (Yes/No). b. Type of inter-cell connector (bolted or others)? c. Materials of inter cell connector.

37	Inter-row, inter tier connectors and end take- off furnished? Description. Size current rating type and material
38	Battery stack / rack.
	<ul style="list-style-type: none"> a. Outline dimensions. b. Type and material. c. Anti-acid coating type. d. Number of trays. e. Height of bottom tier from ground level. f. No. of cells which can be stacked in tray. g. Dimensions of each tray.
39	Total shipping weight of battery units.

40	A dimensional layout drawing of the battery stock / rack along with battery attached with the tender (yes /No)
41	The following characteristic curves to be furnished along with the tender (yes/No).
	<ul style="list-style-type: none"> a. Battery discharge curves at various rates between 1 minute and 10hour rate. b. Curves showing the relation between the cell voltage and charging current, when charged at: <ul style="list-style-type: none"> (i) Finishing rate. (ii) High starting rate. (iii) Two step charging by starting and finishing rate.

Name of the Test	Meters & Equipments required for the corresponding test with range, accuracy, make & Sl. No.	Date of Calibration	Due date of Calibration	Name of the Calibrating Agency	Whether Calibrating Agency is Govt. approved	Whether documents relating to Govt. approval of the calibrating Agency furnished	Whether the meters/ equipments fulfil the accuracy class as per calibration report.	Whether the calibrating agency has put any limitation towards the use of the particular meter/ equipment . If yes, state the limitations	Whether the calibrating agency has put any limitation towards the use of the particular meter/equipment/ meter. State the colour of the affixed sticker	Inspite of imposed limitations. Whether the particular meter / equipment can still be used ? Justify its use for corresponding test(s)	Remarks
1	2	3	4	5	6	7	8	9	10	11	12

SMPS BASED BATTERY CHARGERS

PART – A
TECHNICAL SPECIFICATION
50 VOLT SMPS BASED BATTERY CHARGER

SCOPE:-

This specification covers the design, manufacture, assembly, shop testing at manufacturer's works before dispatch, supply and delivery at site, erection, testing and commissioning of 50 volt 75A SMPS based, SAS compliant float cum boost chargers.

Comprehensive AMC of the said commissioned Chargers for a period of 5 years beyond successful completion of guarantee period.

It is the intention of the purchaser to install the most up to date type of equipment conforming to modern practices.

The scope of supply shall include all parts and accessories etc, which are usual and necessary for erection, operation and maintenance of SMPS based chargers as specified above, though not individually and specifically stated or enumerated.

SCADA Enabled charger shall be provided.

STANDARDS:-

All equipment and their accessories, covered by this specification shall be designed, manufactured and tested in compliance with the latest relevant standards, published by the Bureau of Indian Standards including those, listed at Clause 2.6 in order that specific aspects under Indian climatic conditions are taken care of.

The equipment and accessories for which Indian Standards are not available shall be designed, manufactured and tested in accordance with the latest standards, published by any other recognized National Standards Institution and latest publication of International Electro Technical commission [IEC].

The equipment manufactured according to any other authoritative national / international standard, which ensures an equal or better quality than the provisions of these specifications shall also be acceptable. Where the equipment, offered conform to any other standard, salient points of differences between the proposed standard and the provisions of these specification shall be clearly brought out in the tender. A copy of such standards [in English] shall be enclosed with the offer.

The equipment shall conform to the Indian Electricity Rules, 1956 with latest amendments as regards safety earthing and other essential provisions specified therein for installation and operation of electrical plants.

All equipment shall also comply with the statutory requirements of the

Government of Orissa where the equipment will be installed. Nothing shall be construed to relieve the supplier of his responsibility.

GOVERNING SPECIFICATION:-

The MF-VRLA batteries and the associated chargers shall unless otherwise specified, conform to the following standards. The firms are requested to furnish the following specifications for our further reference.

i	IS-1651/1991	Specification for stationary cells batteries, leads acid type.
ii	IS-1885 [Part-8] / 1986	Electro technical vocabulary: Part- 8-Secondary cells & batteries
iii	IS-266/1977	Sulphuric acid
Iv	BS-46290 (Part-4) / 1997	British standard specification for lead acid type valve regulated sealed type batteries.
v	ANSI, IEEE STD 450/1987	IEEE recommended practice for maintenance, testing and replacement of large lead storage batteries for generating
vi	IEC 896-2/1995	Stationary lead-acid batteries, general requirements and methods of test (part-2, valve regulated types)
vii	IS-(1146 / UI-94) / ASTM - d -29863	Plastic container for lead acid storage batteries.
viii	IS-3136-1965	Specification for polycrystalline semiconductor rectifierequipment
ix	IS-1248-1968	Specification for direct acting indicating analogue electrical measuring instruments and tier accessories. (Part - I)-1983-General Requirements. (Part - II)- 1983 - Ammeters & voltmeters.(Part-III)-1984-Accessories.
x	IS-2208-1962	Specification of HRC Cartridge fuse link up to 650V
xi	IS-2959-1966	Specification of contractors for voltages not exceeding 1000V AC or 1200V DC
xii	IS-3395-1966	Specification for monocrystalline semiconductor rectified cells and stacks.
xiii	IS-4540-1968	Monocrystalline semiconductor rectifier assemblies &
xiv	IS-2147/1962	Degree of protection provided by enclosure for low voltage switchgear and control gear
xv	IS-5578/1984	Guide for marking of insulated conductors.
xvi	IS-8623/1993 [Part 1 to	Low voltage switchgear and control gear assemblies.
xvii	IS-11171/1985	Dry type power transformers.
xviii	IS-11353-1985	Guide for uniform system of marking and identification of conductors and apparatus
xix	IS-13947-1993 (Part 1 to 5)	Low voltage switchgear and control gear

OTHER REQUIREMENTS:-

ACCESSIBILITY AND INTER CHANGEABILITY:-

CHARGER: All working parts, in so far as possible, shall be arranged for convenience of operation, inspection, lubrication and ease of replacement with minimum down time. All like parts of the equipment, furnished shall be inter changeable.

QUALITY AND WORKMANSHIP:-

Workmanship and materials shall be of good commercial quality, suitable for the purpose, intended and in accordance with the highest standards and practices for equipment of the class, covered by this specification.

SAFETY:

All equipment shall be complete with approved safety devices wherever a potential hazard to personnel exists and with provision for safe access of personnel to and around the equipment for operational and maintenance functions. The design shall include all necessary precautions and provisions for the safety of operating and maintenance personnel.

Special care shall be taken to make enclosed equipment proof against entry of rat, lizards and other creeping reptiles, which may create electrical short circuits inside, live equipment.

Continuity of power supply is the first consideration and the design shall be such as to provide facilities to simplify inspection, testing maintenance, clearing and repair at site.

SPECIAL SITE CONDITIONS:-

The equipment with their accessories shall be designed for smooth, efficient and trouble free operation in tropical humid climate for maximum temperature of 50 degree C and maximum humidity of 98 percent. Maximum temperature and maximum humidity are however not likely to occur simultaneously. De-rating of equipment shall be done for an ambient temperature of 50 degree C.

PAINTING:-

All items of equipment and materials shall be thoroughly cleaned and painted in accordance with IS Specification. The clean surface shall be given two coats of epoxy polyamide resin based red-oxide zinc-phosphate primer, deposited either by immersion or powder spray. The phosphate coated surface shall have one coat of high build epoxy resin based intermediate paint coating and two coats of air drying epoxy polyamide enamel suitably pigmented finish paint. The colour shade for exterior parts of equipment located inside the sub-station control room building shall be as per shade No. 631. Clean and touch-up paint shall be applied at site as required.

PART-B

**TECHNICAL SPECIFICATION FOR 50V- 75 Amp
SMPS BASED AUTOMATIC FLOAT-CUM-BOOST CHARGERS SUITABLE
FOR 48V MF-VRLA BATTERIES.**

1. SCOPE:

This specification covers the design, manufacture testing before dispatch, delivery at site and erection, testing & commissioning at site of 50V Automatic Float-cum- Boost Charger of different capacities and comprehensive AMC thereof for 5(Five) years beyond successful completion of guarantee period..

2. BASIC REQUIREMENT:

The charger shall preferably be modular type based on high frequency switching mode power supply(SMPS) technique using IGBT devices and the front mounted SMPS modules should be hot swappable.

The float -cum- boost charger shall be suitable for charging 48V battery in addition to trickle charging and feeding power to communication equipment whenever AC mains supply is available to the charger.

In spite of the fluctuations in the voltage and the frequency variation of mains supply to the charger, there must be line regulated DC output voltage for feeding the communication equipment load. The DC output voltage shall also be load regulated.

In the event of mains supply failure, the batteries shall supply total load current as long as the battery is not discharged below 40V. A Low Voltage Disconnect (LVD) should protect the battery from deep discharge. On restoration of main supply the float-cum-boost charger shall resume its normal function of charging the battery as well as feeding communication equipment load automatically.

Depending on the status of battery i.e., voltage per cell and previous discharge history, there shall be need for automatic switching between float and boost charging. Separate outputs for battery and equipment should be available, otherwise dropping diode technique may be used to prevent boost voltage appearing across the load.

Digital Control: charger should employ digital control with DSP controller for providing predictive control of rectification & monitoring capability. The charger should have a multi line dot matrix display of suitable size, on front panel to indicate control status and event log.

The side and top panels of the equipments should be designed in such a way to allow sufficient ventilation for the components. The ON – OFF switch, input and output fuses,

indication lamps, voltmeters, ammeters, filters, condensers fuses, output voltage control are to be provided on the front panel. Cable entry holes shall be provided at the bottom with suitable clamping arrangements.

COMPONENTS:

Components used shall be of professional grade of reputed manufacturer. Iron and ferrite core transformer and chokes if used shall be wound with copper with adequate insulation provided.

The positive output of SMPS units must be connected to common ground. Circuit breakers, output fuse, ammeter shunt etc should be provided on the negative path of the output. Sensing circuit, fuses or circuit breakers shall be provided wherever appropriate to protect the charger.

Suitable mechanical front loading rack arrangement for holding modules in position shall be provided so that the modules are held firmly by sliding through it.

Efficient earthing of the Charger shall be provided, taking care that in communication system 48V DC positive is always connected to earth.

PROTECTION:

Protection circuit should be provided for the following cases:

- i) **Under voltage / over voltage for both input and output.**
- ii) **Over load / short circuit.**
- iii) **Battery earth Fault**
- iv) **SMPS Unit failure.**
- v) **Wrong battery connection/reverse polarity**
- vi) **Power ON self test**
- vii) **Supply wrong phase, phase failure.**

VISUAL INDICATION:

Visual indication such as LED, Dot matrix LCD etc. shall be provided to indicate:

- (a) Mains available
- (b) Phase failure / wrong phase
- (c) Charge/ Discharge
- (d) Charger over load
- (e) Float mode/ Boost mode
- (f) Output fail
- (g) Battery Low.

ALARM FACILITIES:

The equipment shall be provided with audio alarm facility for all the conditions as mentioned in Protection above with suitable resetting facilities. The audio alarm in respect of the above conditions should automatically reset itself after a lapse of 30 seconds. The visual indication should persist till the fault is cleared. Potential free contact shall be provided for extension of alarm for centralized display.

COMPONENT MARKING:

Each electrical component should be located on the PCB by the layout/ circuit diagram. The wiring shall be clearly and permanently identified with a designation or a colour code which must correspond to the equipment circuit diagram.

CABINET:

Free standing steel cabinet 1.6/2.0
Or above gauge sheet steel. Degree of protection not less than IP42.

NAME PLATE:

A name plate etched, engraved, anodized or any other better arrangement ensuring better life expectancy shall be suitably fixed on the cabinet of the charger and should contain following information.

- a) Specification No.
- b) Type of the unit
- c) Manufacturers name
- d) Model No.
- e) Serial No.
- f) Input voltage and phase
- g) Output voltage and current
- h) Year of manufacture

HEAT – RUN:

All units shall be subjected to heat run test of 12hours at full load and temperature of component shall not be more than as mentioned below:

- a) Transformers and chokes - 70deg C
- b) Transistors / diodes /FETs - 60 deg C or as per component spec.

INSULATION RESISTANCE:

The insulation resistance of the charger when tested with a 500V DC megger shall be as given below.

- a) AC input and earth - Greater than 2 Meg. Ohms.
- b) DC output and earth - Greater than 1 Meg Ohms.
- c) AC input and DC output - Greater than 5 Meg ohm

LIGHTNING PROTECTION:

The system shall be adequately protected against lightning at the input.

RADIO FREQUENCY INTERFERENCE SUPPRESSION:

The equipment should be designed to minimize the level of electromagnetic interference both conductor and radiator, detected in the vicinity of the equipment and generated by switch mode power conversion equipment inside the charger.

TOTAL VOLTAGE HARMONIC DISTORTION:

The total line harmonic voltage distortion shall not be more than 10%.

TOTAL CURRENT HARMONIC DISTORTION:

The total current harmonic distortion contributed by the unit shall not exceed 20% for all input condition and load 50% to 100% of the rated capacity.

MANDATORY SET OF SPARES:

The suppliers shall provide the following mandatory spares for each of Charger supplied.

- | | | | |
|-----|--|----|------------------|
| (a) | AC Contactor (if used in the charger) | :- | 1no./ charger |
| (b) | DC Contactor (if used in the charger) | :- | 1 no. / Charger. |
| (c) | Required HRC Fuses of appropriate rating:- | | 4 nos./ charger |

INSTRUCTION AND MAINTENANCE MANUAL:

Two copies of the instruction manual shall be supplied along with each unit. The manual has to include dimensioned layout drawings, detailed circuit and schematic diagrams, PCB layout and detailed inter connecting drawings of modules and switching arrangements. Details on testing and adjustment procedure, initial check on receipt at site, detailed installation and commissioning procedure, maintenance procedure, proposed routine maintenance tests, actual test results obtained for the particular unit at the factory.

Detailed trouble shooting chart shall be outlined in the manual.

Instruction manual is to be prepared using good quality paper. All drawings in Clear printing shall be attached to the manual along with the flow chart drawing necessary for trouble shooting.

The bidder shall arrange for training of at least five Telecom. Engineering personnel of OPTCL on operation & maintenance of 50 V Float- Cum-Boost chargers free of cost. Every details regarding repair of all probable defects need be imparted to the trainee engineers at works of the manufacturer. The bidder in their offer need intimate the duration of training. However the training must be conducted prior to delivery of the Battery chargers.

TYPE TEST:

The bidder shall submit the test reports along with his offer for the following type tests conducted on the offered samples as per relevant National Standard (s) and test- witnessed by any Government Department /Government undertaking, failing which the offer is liable for rejection.

- a) Measurement of Power loss/ consumption in rectifier auxiliaries
- b) Equipment reactance test
- c) Measurement of voltage regulation / AVR regulation
- d) Efficiency and power factor measurement test
- e) Temperature rise test so as to determine the temperature rise of Semiconductor, Ferrite cores and cabinet etc.
- f) Measurement of insulation resistance
 - (i) AC input to earth.
 - (ii) AC input to DC output.
 - (iii) DC output to earth
- g) DC voltage current characteristic
- h) High Voltage Tests.
- i) Determination of regulation
- j) Measurement of ripple
- k) Reverse leakage test
- l) Test for confirmation of reduction in float voltage with increase of battery temperature and vice-versa.

The bid offers in confirmation to the above tests as well as the tests certified by **Telecom RDSO center and followed by REL-TEL** shall be given due weight age.

ACCEPTANCE TESTS:

Followings shall constitute the acceptance tests which shall be tested by the purchaser's representative at the works of the manufacturer at the cost of the supplier for each charger. No sampling is allowed.

- (a) Measurement of voltage regulation
- (b) Efficiency and power factor measurement
- (c) Temperature rise test so as to determine the temperature rise of Semiconductor capacitor, choke, Ferrite cores and cabinet etc.
- (d) Measurement of insulation resistance.

- (i) AC input to earth
- (ii) AC input to DC output
- (iii) DC output to earth

- (e) DC voltage current characteristic
- (f) High voltage tests.
- (g) Determination of regulation.
- (h) Measurement of ripple
- (l) Tests for indications and alarms as per this specification
- (j) Tests for indicating instruments.
- (k) Determination of system set points.
- (l) Soft start test

N.B.: The supplier shall provide arrangements for monitoring the temperature across the elements, as stipulated above, continuously during the temperature rise test without disconnection of any of the temperature measuring devices across the hottest spot of each of the above elements.

All other tests, as may be necessary to ensure that all equipment's are satisfactory shall also be carried out. In addition to the above tests, manufacturer's test certificates, vendor's test certificates for different equipment's, accessories, instruments etc. shall be submitted, whenever required by the purchaser.

DRAWINGS / DOCUMENTS:

The bidders shall submit the following drawings / documents along with their offer failing which the offer is liable for rejection.

- (a) OGA of the battery chargers
- (b) General layout with overall dimensions
- (c) Electrical schematic diagram showing connections and controls.
- (d) Leaflets and technical literature giving detailed information of the panels offered.

The bidder shall submit the following drawings / documents in 3 (three) copies within 15 (fifteen) days from the date of issue of the purchase order for purchaser's approval.

- (a) OGA of the battery chargers
- (b) General layout with overall dimensions marked along with sectional views showing cable entry position etc.
- (c) Rating calculations for power semiconductors, torridly transformers, capacitors inductors etc.
- (d) Detailed schematic and connection and control wiring diagram for all the equipment.

- (e) Complete bill of materials
- (f) Technical excerpts on operation.

GUARANTEED TECHNICAL PARTICULARS

The guaranteed technical particulars of this specification shall be furnished along with the tender. Any tender, lacking complete information in this respect is likely to be rejected.

DEVIATION FROM SPECIFICATION:

All deviations from the specification shall be separately listed in the technical deviation sheet, in the absence of which it will be presumed that the provisions of these specifications are complied with by the tenderer. Any extra feature/equipment/ instrument as necessary for operation and performance of the battery charger for the 48V MF-VRLA batter set as per this specification shall be provided without any extra cost to OPTCL. **The extent of up gradation facility shall be mentioned.**

TRANSPORT:

The chargers along with its accessories shall be suitably packed and transported to site in ready to use condition.

BRIEF TECHNICAL SPECIFICATION:

The required capacity of chargers may be 50V-75AChargers of 75 Amp. Rating and above shall be of 3 phase type.

Charging Curve: Completely programmable. Should support batteries of anytype, voltage, capacity.

- a) Input Voltage: - 230 □ 20% VAC single phase in case of 25A, 40A and 50A charger.
400 □ 20% VAC three phase in case of 60A, 75A,125A and 160A charger

Frequency – 50Hz □ 5%

Power factor – Single phase model- > 0.90 at full

loadThree phase models >0.97 at full load

Voltage withstand test – 1500V AC input to chassis for 1 minute.

- b) Float mode – Adjustable 48V – 52 V Trickle charging of

battery and simultaneously supplying the load.

Boost mode – Adjustable 48V – 65V

Boost charging of battery and simultaneously supplying the load after suitable voltage dropping arrangement.

Static Regulation – Line : $\leq 0.5\%$

Load: $\leq 0.5\%$

Dynamic Regulation: $\leq 0.5\%$ for 10% - 90% - 10% stop load change.

$\leq 1\%$ within 1 m sec. Of stop change.

$\leq 1\%$ for $\leq 25\%$ stop change in AC input voltage.

Phosphometric noise (emf weighted at 800 Hz)

< 2mV rms while delivering full rated load at normal

input. Out Ripple: - Less than 1% RMS at full load.

EFFICIENCY:

a) Single Phase AC

i) At normal input, output and full rated load: - Better than 85%.

ii) For other specified input output condition and load between 25% to 100%: - Better than 80%.

b) Three Phase AC

i) At normal input, output and full rated load : - Better than 90%

ii) For other specified input, output conditions and load between 25% to 100% : - Better than 85%.

ANNEXURE – II

GUARANTEED TECHNICAL PARTICULARS FOR BATTERY CHARGER (48V D.C. SYSTEM) SUITABLE FOR SPECIFIED MF-VRLA TYPE STORAGE BATTERY

(To be filled in by the Bidder)

1. MANUFACTURER’S NAME
2. RATED OUTPUT OF THE CHARGER
Voltage (volts)
Current (amps)
Power factor
3. SHORT TIME RATING
4. TYPE OF COOLING
5. HOTTEST STACK TEMPERATURE (°C)
6. CHARGER DIMENSIONS
(a) Height (mm) :
(b) Depth (mm) :
(c) Width (mm) :
(d) Sheet thickness (mm) :
7. CHARGER WEIGHT :
8. CHARGER RATED OUTPUT CURRENT
(a) Float charging mode :
(b) Boost charging mode :
9. LOAD LIMITER CURRENT SETTING RANGE (Trickle mode)
10. AUTOMATIC VOLTAGE REGULATOR MODULE
manufacturer’s name
Manufacturer’s type
Percentage stabilization of the rectifier with the help of AVR when
(a) Input voltage changes with □ of its nominal value.
(b) DC output of the rectifier varies from no-load to full load.
Rated output voltage
Allowable AC frequency fluctuations

Voltage setting range

Response time of automatic voltage regulator

CONTACTORS / MOULDED CASE CIRCUIT BREAKERS

Type

Make

Rated voltage (V)

Rated continuous currents (A)

Contact material

Operating coil

Voltage (V)

Voltage range and power for closing and holding

Voltage range and power for drop off.

Details of CT if any

Auxiliary contacts.

Number

Current rating

Characteristics of back-up HRC fuse.

RELAYS :

Make and type of protective and alarm relays

- (a) Thermal overload relay
- (b) Input under voltage relay
- (a) Single phasing alarm relay
- (b) Phase reversal relay
- (c) D.C. output over-voltage relay
- (d) D.C. output under voltage relay
- (e) Charger failure relay
- (f) Battery earth fault relay
- (g) A.C. input failure relay (for connecting the D.C. load)
- (h) Fuse failure relay
- (i) Alarm accept relay

Rated voltage of each of the above

- (a) AC/DC
- (b) Permissible variation
- (c) Frequency

VA burden of each of the above

Operating time of each of the above

Reset time

Accuracy

Setting range

Reset factor

Number of contacts

- a. Normally open
- b. Normally closed

Rating of contacts

- (a) Rated Voltage (V)
- (b) Rated making and breaking
- (c) Continuous rating

Operation indicator

13. INDICATING LAMPS/ LCD DISPLAY

Manufacturer's name

Type and designation

Permissible voltage variation

Rated power consumption (watts).

Series resistance, if any

14. SWITCHES:

Manufacturer's name

Ratings

- (a) Continuous current
- (b) Short circuit – making capacity
- (c) Breaking capacity
- (d) Voltage

Operating mechanism details

Type of visual indication

- (a) OFF and ON position
- (b) Fuse blow out

FUSES/Circuit breaker

- (a) Make
- (b) Type
- (c) Rating (Amps)
- (d) Interrupting rating (KA)

16. INSTRUMENTS

Manufacturer's Name

- (a) Ammeter
- (b) Voltmeter

Type

- (a) Ammeter
- (b) Voltmeter

Ammeter

- Float charger
- Boost charger
- Battery float
- Battery boost

Volt meter

- Input supply
- Charger output
- Load

16.5 Size of dial

- (a) Volt meter
- (b) Ammeter

16.6 Accuracy class

- (a) Volt meter
- (b) Ammeter

Temperature at which calibrated

Limit of errors

Outline dimensions

Type of mounting

Selector switch for volt meter (AC & DC)

j) make

k) rating

- 17 Reference float voltage at ambient temperature of 27°C
- 18 Whether protection is given for float voltage to Avoid low battery voltage dueto sensor or circuit Malfunction. (Yes/ No)
- 19 Whether the positive output of SMPS units is connected to common ground.Circuit breakers, output fuse, ammeter shunt etc are provided on the negative path of the output (Yes/No).

ANNEXURE – IV-A

(For Testing of Battery) (To be filled in by the bidder)

CALIBRATION STATUS OF TESTING EQUIPMENTS AND INSTRUMENTS/ METERS

Name of the Test	Meters & Equipments required for the corresponding test with range, accuracy, make & Sl. No.	Date of Calibration	Due date of Calibration	Name of the Calibrating Agency	Whether Calibrating Agency is Govt. approved	Whether documents relating to Govt. approval of the calibrating Agency furnished	Whether the meters/ equipments fulfil the accuracy class as per calibration report.	Whether the calibrating agency has put any limitation towards the use of the particular meter/ equipment . If yes, state the limitations	Whether the calibrating agency has put any limitation towards the use of the particular meter/equipment/ meter. State the colour of the affixed sticker	In spite of imposed limitations. Whether the particular meter / equipment can still be used ? Justify its use for corresponding test(s)	Remarks
1	2	3	4	5	6	7	8	9	10	11	12

Signature of the tenderer with seal & date

ANNEXURE – IV-B

(For Testing of Battery Charger) (To be filled in by the bidder)

Name of the Test	Meters & Equipments required for the corresponding test with range, accuracy, make & Sl. No.	Date of Calibration	Due date of Calibration	Name of the Calibrating Agency	Whether Calibrating Agency is Govt. approved	Whether documents relating to Govt. approval of the calibrating Agency furnished	Whether the meters/ equipments fulfil the accuracy class as per calibration report.	Whether the calibrating agency has put any limitation towards the use of the particular meter/ equipment. If yes state the limitations	Whether the calibrating agency has put any limitation towards the use of the particular meter/equipment/ meter. State the colour of the affixed sticker	In spite of imposed limitations. Whether the particular meter / equipment can still be used ? Justify its use for corresponding test(s)	Remarks
1	2	3	4	5	6	7	8	9	10	11	12

Signature of the tenderer with seal & date

ANNEXURE V

(To be filled in by the bidder)

**CHECK LIST TOWARDS TYPE TEST
REPORTS FOR BATTERY CHARGER**

Name of the Type Test	Date of Test	Name of the Laboratory where the Test has been conducted	Whether the Laboratory is Government approved	Whether the Test report is valid as per Spn.	Whether the Test report in complete shape along with drawings etc. furnished or not ?	Whether the type tested battery charger fulfills the technical requirements as per TS	If the type tested battery charger does not fulfill the technical requirements as per this specification, whether the bidder agrees to conduct the particular type test again at their own cost without any financial liability to OPTCL in the presence of OPTCL's representative within the specified delivery period	Remarks
1	2	3	4	5	6	7	8	9

Signature of the tenderer with seal

PART-23
250KVA STATION TRANSFORMER

TECHNICAL SPECIFICATION FOR 250KVA, 33/0.433kV STATION TRANSFORMER

1. TYPE:

The Transformers shall be of the outdoor core type double wound oil immersed self-cooled type 'ON' and conform to ISS 1180/2014 and 2026/1977 with up-to-date amendments.

All the transformers shall be suitable for operation in humid atmosphere in the tropical place with ambient temperature ranging from 50° to 60°C.

2. STANDARD:

The transformers shall comply with ISS 2026/1977, 1180/2014 & the latest version thereon & CBIP standards with Class-A materials specified therein and should be designed taking ambient temp. as 50°C.

3. RATING:

The transformer shall have core type copper wound construction, oil immersed 'ON' suitable for out-door service as a step down transformer. The rating and electrical characteristics of the transformers shall be as follows:

Sl. No.	Description	250KVA
1	Frequency	50 Hz ± 5%
2	Rating	250kVA
2	Rated HT/LT voltage	33/0.433KV
3	Nominal voltage ratio (HV/LV)	33 / 0.433 kV
4	Type of cooling	ONAN
5	Method of connection	HV – Delta LV – Star
6	Connection symbol	Dyn11
7	Percentage impedance at Continuous maximum Rating at 75° C	-5% to +7.5% in steps 2.5% in high voltage side
9	Type tap changer for transformer	(Rotary type, off load control tap changing gear.
10	BIL	170KVP
11	Terminal connection	Bimetallic clamp suitable for ACSR conductor as per system Requirement.
12	Maximum flux density at normal Voltage & normal frequency	1.4 Tesla

4. The primary-winding shall be connected Delta and secondary winding star as per

vector symbol Dyn-11(IS: 2026/1977). The terminal arrangement shall be out door bushing suitable for bare ACSR – Twin Zebra conductors for 33 KV side and to suit 3 ½ x300 mm² armoured PVC cable with cable end box for 433 volt side.

The temperature rise should not exceed the limits stated in relevant standards. The transformer shall be capable of withstanding thermal and mechanical effects, of a short circuit on the terminals of any winding with full voltage maintained on other windings for duration of at least five seconds.

5. INSULATION:

- 5.1 The electric strength of the winding insulation and of bushings shall confirm to the values given in the IS: 2026/1977.
- 5.2 For rated system voltage of 33kV, the impulse test voltage is 170kV (Peak) & power frequency voltage is 70kV.
- 5.3 All windings of the transformer shall have uniform insulations.

6. VOLTAGE RATIO:

- 6.1 The transformers shall be for the rated kV specified on the HV side and on the LV side.
- 6.2 The insulation and magnetic circuit shall be suitable for working continuously at 10% in excess of the normal voltage and at the same time at a frequency of 3% below the normal.

7. CURRENT DENSITY:

The current density in windings shall be kept within 2.4 A/sq.mm.

8. FLUX DENSITY:

The maximum induction with maximum system voltage i.e. 36 kV& frequency, and the type of steel used for core laminations should be stated in the tender.

Flux density at maximum system voltage i.e.36 kV and lowest frequency 48.5 C/S shall not exceed 1.6 Tesla.

9. FRERQUENCY:

The transformers shall be suitable for continuous operation with a frequency variation of plus or minus 3% from the normal frequency of 50 Hz without exceeding the temperature rise specified in clause – 17.

10. TERMINAL ARRANGEMENTS:

HT side – Bimetallic clamp type, suitable for ACSR conductor as per requirement and layout.

LT side – cable connection, 3 ½ x 300 mm² armoured PVC aluminium cable. The neutral of the star end brought to a separate insulation terminal for earthing purpose.

11. TAPPINGS:

Tappings range shall be 12.5% in steps of 2.5% and it shall be off load type with local control. The taps shall provide for voltage adjustment on the high voltage side from – 5% to +7.5% of the rated voltage, the tappings being located on higher voltage

winding.

The transformer shall be so designed that the temperature rise is maintained within limits, specified in relevant standards when operated at full output or constant primary service voltage on any primary tapings irrespective of the tapping corresponding to the service voltage.

An externally operated off circuit tapping switch shall be provided to enable changing of taps without removing the transformer cover or lowering of the oil level. The transformer shall give full rated KVA output of each winding at all the taps.

The switch mechanism shall be so designed as to prevent the entry of moisture into the tank. The design of the switch mechanism shall ensure that the switches are making full contact and then only it shall be possible to look the operating mechanism. The tap mechanism shall be provided with a locking device.

12. BUSHING TERMINALS:

All main winding and neutral leads shall be brought out through outdoor type bushing suitable for bare copper or ACSR conductors for 33 kV side and to suit for 3 ½ x 300 mm² Armoured PVC cable for 433 volt side & so located that the full flash over strength will be utilized.

Each bushing shall be so coordinated with the transformer insulation that all flashovers will occur outside the tank. The porcelain used for the bushings shall be of the wet processed type, homogenous and free from cavities or other defects. The glaze of the porcelain parts shall be uniform in colour and free of blisters, burns and other defects.

The bushings should conform to IS: 2099/73 and with 3347(Part-I &II Section – 1 & 2) with its latest amendments.

13. FLASHOVER CHARACTERISTICS OF BUSHINGS:

The spacing between the bushings must be adequate to prevent flash over between phases under all condition of operation. Special adjustable coordinating gaps should be provided on the high-tension terminals and the gap setting adjusted with reference to the impulse coordination of the system. The tenderer is requested to give the guaranteed withstand voltage for the impulse and flash over values of the bushings.

14. SUPPRESSION OF HARMONICS:

The transformers shall be designed with particular attention for suppression of harmonic voltages especially the 3rd and 5th so as to eliminate wave form distortion and any possibility of high frequency distortion and any possibility of high frequency disturbances, inductive factor or of circulating current between neutral point at the different transformer station reaching such a magnitude as to cause, interference with post office or other communication circuits.

15. CENTRE OF GRAVITY:

The center of gravity of the assembled transformer shall be low and as near the vertical centerline as possible. The transformer shall be stable with or without oil. If the center of gravity is eccentric to the vertical line either with or without oil, its location shall be shown on the outline drawing.

16. VIBRATIONS AND NOISE:

The transformers shall operate without undue vibration and noise and shall comply with NEMA publication – TR – 1.

17. TEMPERATURE RISE:

Each transformer shall be capable of operating continuously at this normal rating without exceeding temperature rise limits as specified below:

- i) Winding 55°C by resistance measurement.
- ii) Top oil 50°C by thermometer measurement.

The above limits are with an ambient temperature of 50° maximum. All transformers shall comply with requirement of IS: 2026/77 & its latest amendments as regard the rating and temperature rise.

18. EFFICIENCY:

The efficiencies of the transformer corresponding to 25%, 50%, 75%, 100% and 125% load may be specified. Maximum efficiency should occur at 50% load.

19. PERCENTAGE IMPEDENCE:

The transformer offered must be designed for a minimum impedance of +5% at 75°C. No negative tolerance on impedance is allowed.

20. LOSSES:

The no load & load losses shall not exceed the values given in the following

Ratings	TOTAL LOSSES (no-load + load losses at 75 ⁰ C) AT 50% LOAD IN WATTS	TOTAL LOSSES (no- load + load losses at 75 ⁰ C) AT 100%LOADIN WATTS	PERCENTAGE IMPEDANCE AT 75 DEGREE C AT NORMALTAP
250kVA(Copper wound)	1054	3150	4.5 (Minimum)

The above losses are maximum allowable losses & there shall not be any +ve tolerance on the losses for the transformers. Bid evaluation will be done taking in to consideration the quoted no load & load loss figures. The purchaser reserves the right to reject the whole lot of supply in case the loss figures exceed the limit given in above table at the time of testing.

21. PARALLEL OPERATION:

The transformers with similar connection shall be capable of operating in parallel on corresponding taps and of sharing loads in proportion to their ratings subject to the tolerances of impedance.

22. WINDING AND INSULATION:

All permanent current carrying joints shall be welded or brazed. All threaded connections shall be provided with locking facilities.

The assembled core and coils shall be properly dried before impregnation. The process of impregnation should be stated.

All leads from the winding shall be rigidly supported to prevent injure isolation due to vibration. Flexible tubes shall be used where practicable.

The HT and LT winding of all transformers shall be of the fully insulated type.

- a. Special attention should be given to provisions of adequate insulation and clearances between HT and LT windings and live parts must be adequate for normal voltage of operation plus 10%.
- b. The end turn insulation of the transformers shall in conformity with latest practice.
- c. Windings shall be circular and concentric with the HT windings on the outside. All similar coils shall be inter changeable.
- d. The windings shall be made of paper insulated continuous & smooth electrolytic copper conductor. The insulation of coils & assembly of windings shall be insoluble, non-catalytic and chemically inactive in the hot transformer oil. The insulation shall be of class "A" category.
- e. The insulation of the transformer winding and connection shall be free from insulating compound which may so often coagulate shrink or collapse during service. None of the materials used shall shrink, disintegrate, carbonized or become brittle under the action of hot oil when the transformer is operated continuously with the conductors at any temperature which may be reached at the specified loading conditions.

The finished width of any oil ducts shall be such and the clamping arrangement shall be so designed as not to impede the free circulation of oil through the ducts.

23. BRACING OF WINDINGS:

Windings connections and tappings of the transformers shall be braced to withstand the shocks, which may occur during transport and during service due to short circuit, switching or other transient condition. No mechanical movement of coils shall be possible with dead short circuit on either side of the transformer. The short circuit rating shall be as per Clause 9.1 ISS: 2026/1977.

24. MAGNETIC CIRCUITS:

The transformers core shall be of high grade non-ageing, electrical silicon steel cold-rolled laminations each coated with hot oil proof, lead enamel insulation clamped together firmly to the frame to ensure even pressure over the whole of the core laminations and to prevent undue vibration and noise. After being sheared the laminations shall be treated to remove all burns and shall be re-annealed to remove all strains.

Paper or varnish insulation shall not be accepted. The joints in the core shall be interleaved and in no account will 'Butt Joints' be accepted. Suitable axial cooling ducts suitable proportioned to prevent excessive temperature rise must be provided to ensure free circulation of oil and efficient cooling of the core. The clamping structure shall be so constructed with MS Channels, and insulated bolts and so designed that eddy currents is minimum and hood must not be used for the purpose. The core shall be designed and build up in such a manner as to avoid accidental or slow development of short circuit plates through iron and frame.

The core and coils shall be so fixed in the tank that their shifting will not occur when the transformer is moved.

Means shall be provided for earthing the core and framework at one point only.

25. TRANSFORMER TANK:

The tank and cover of each transformer shall be of welded boilerplate with suitable stiffeners so constructed that all joints are hot oil tight and bulging does not occur in service. The tank shall be so designed that with the minimum dismantling necessary, the core and winding can be lifted free of the case. External lugs or eyes for lifting the core or windings shall be provided. Ample space shall be provided with an appropriate arrangement of things, suitable for lifting transformer core with winding. The tank shall be fitted with a substantial under carriage and provided with rollers. The minimum thickness of the bottom & top plates shall be 6 mm and side plates shall be 4mm.

26. OIL:

Sufficient quantity of oil shall be supplied with each transformer for filling each tank, bushing and conservator to the proper level. The oil shall be in accordance with IS No.335/1972 & its latest amendments. Oil test certificates shall be furnished at the time of inspection of transformers in support of the use of new unused oil conforming to IS 335 in the transformer.

27. EARTHINGS:

The core and tank cover shall be earthed to the tanks by means of copper connection capable of carrying for 30 seconds without injury and over loading with earth fault current not less than full load current of the main transformer. In no case shall the cross sectional area be less than 0.1 sq. inch. Two earthing terminal shall be provided suitable for No 7 SGW bare copper wire with suitable soldering lugs.

28. TANK FITTINGS AND ACCESSORIES:

The standard fittings to be provided on each transformer in line with manufacturers practice may be provided including the following:-

- a. Oil conservator of sufficient capacity to prevent inadvertent operation of Buchholz relay where used and shall be provided with drain plug/valve oil gauge, with a mark to indicate oil level at a temperature of 50° C filling cap. Silica Gel dehydrating breather to contain minimum 0.5 kg dehydrated silica gel.

- b. Explosion Vent A safety valve of chimney type shall be provided. The bottom of the safety valve pipe shall project into the tank.
- c. Glass Type Thermometer:
Mercury in glass type thermometer mounted on the top of the transformer to read the temperature in the hottest part of the oil.
- d. Drain Valve:
1" (15mm) drain valve cum lower filter valve suitable for connection to the flange of the same diameter. The valve should be fitted with an adopter for 16 mm hose for filtering purposes. The valve shall be located so as to enable with drain out of the oil from the tank. This valve shall be equipped with a small sampling cock.
- e. Earthing terminal and numbers.
- f. Air relief vent.
- g. Rating and diagram plate:
The rating plate should bear the data specified in the proper clauses of ISS-2026/1977. The diagram plate should also show the internal connection and so the voltage vector relationship of the several windings in accordance with IS: 2026/1977 and in addition a plan view of the transformer giving accurate physical relationship with the terminals.
- h. Oil filter valve:
The oil filter valves should be fitted with adopter for 16 mm hose. These valves are for oil filtration and for draining of oil for sample and test purpose.
- i. Joint and Gaskets:
All joints in the transformer and auxiliary equipment shall be made in such a manner as to prevent ingress of moisture of leakage of oil.
- j. Arcing horn with each HT bushings.
- k. Pad lock for tap changing switch.
- l. Accessory equipment not specifically listed above but normally regarded as standard shall be provided in accordance with relevant clauses of IS: 2026/1977 & CBIP practice.

29. PACKAGE:

The packing may be in accordance with the manufacture's standard practice. The bushings shall be packed and dispatched separately. Full details of packing for approval of the purchaser should be given. The package shall be such to satisfy the conditions of transport by rail and road to existing place where the transformer is to be erected and also be suitable for rough handling.

30. PAINTING:

Before dispatch all steel work not under oil shall be painted with a primary coat of anti-corrosive paint of durable nature and one coat of final finishing paint. The transformers shall be painted with heat resisting dark grey paint sand blast painting will be preferred.

31. TESTS:

The transformers shall be subjected to stage inspection of core, windings, tanks and fittings before the final inspection. Test certificates from manufacturer for core, conductors, oil, mild steel used for tanks, insulations and etc. shall be furnished to the purchaser before calling for stage inspection. After the successful stage inspection, final inspection, type tests & routine tests will be carried out as mentioned below & in accordance with Indian Standard Specification No. 2026/1977 at Manufacturer's works before dispatch to site.

The purchaser reserves the right of having other reasonable tests carried out at his own expenses either before dispatch or at site to ensure that transformer complies with the requirement of the specification. The test certificates (for both stage inspection & final inspection, tests) in triplicate shall be submitted as soon as the tests are completed for approval.

31.1 Before calling for final inspection, the supplier shall furnish the factory test results (routine and additional routine test results) of the offered transformer along with list of equipment used during testing with serial number, make, class of accuracy, the valid calibration certificates of the equipments/instruments used during testing to the owner for owner's information and reference. On verification of the test results, measuring instruments & calibration certificates, the owner may direct the contractor for use of better equipments/meters during inspection/testing.

31.2 Routine & type tests are to be conducted at the manufacturer's factory as per IS: 2026/1977 & as indicated below, in presence of purchaser's representative. Routine and type test certificates are to be submitted in support of the tests conducted successfully, after which dispatch clearance will only be issued. Type tests as indicated below will only be conducted on one transformer per lot.

31.3 Routine Test:-The followings shall be regarded as routine tests and shall be conducted at the manufacturer's work on each transformer in presence of purchaser's representative. No extra cost shall be paid for these tests.

- a. Measurement of winding resistance at normal & extreme taps.
- b. Ratio, polarity and phase relationship & vector group test.
- c. Impedance voltage / short circuit impedance at the normal tap & extreme taps.
- d. Measurement of load loss and neutral unbalance current:
This test shall be carried out with three wattmeter's method with low power factor wattmeter, low range Ammeters and phase sequence meters. The measurement shall be made at 100% rated current & rated frequency, but in

no case not less than 80% current of the rated current (Principal tapping) or tapping current (in case of extreme taps). Load loss measurement to be done on the normal tap (rated voltage tap) and extreme taps.

e. Measurement of no-load loss and no load current:

This test to be carried out with 3 wattmeter method by using low power factor watt-meters, 3 power factor meters, phase sequence meters, three low range ammeters and three each average value and RMS value voltmeters. The test voltage from 10% voltage to 121% voltage shall be applied and currents, voltages (Average value and RMS value), wattmeter, power factor and frequency meter readings in all the 3 phases to be recorded during the test. A voltage (RMS) vs. measured current graph shall be plotted by the supplier and handed over it to the purchaser for analysis.

During the test, supplier's own generator set shall be used for feeding the rated voltage at rated frequency. If the applied frequency is greater than the rated frequency, then proportionate voltage to the rated frequency will be fed during the test and following frequency correction formula along with the formula given in Clause 16.5 IS:2026(Part-I) shall be used.

$$K = 0.5/f + 0.5 (f/f_1)^2$$

Where f = rated frequency & f₁ = applied frequency.

For example: - If measured loss = x, correction factor due to rms & Average voltage as per ISS = k₁, and frequency correction factor = k. Then corrected loss will be calculated as = measured loss x * k₁ * k. If applied frequency is less than the rated frequency, then no frequency correction formula will be applied. Rated voltage at that frequency will be fed during the test.

- f. Insulation resistance Test by motorized megger:-**Insulation resistance values to be taken at 1 minute & at 10 minutes intervals. Ratio of insulation resistance taken at 10 minutes and at 1 minute should not be less than 1.5.
- g. Induced over voltage withstand.**
- h. Separate sources voltage withstand.**
- i. Magnetic balance test**
- j. Oil BDV Test**
- k. Oil Leakage Test**
- l. Measurement of dimensions &etc.**

31.4 Type test:-The followings shall be regarded as type tests and shall be conducted at the manufacturer's work on one unit out of the lot at the discretion of the purchaser, in presence of purchaser's representative. Charges if any for conducting each type test shall be quoted in the relevant price schedule.

- a. Temperature rise test

- b. Oil Leakage & Pressure Test: - The transformer tanks shall be subjected to a pressure equal to the normal pressure + 35 KN/m² measured at the base of the tank. Pressure shall be maintained for a period of 12 hours for oil during oil leakage test and 1 hour for air during Pressure test on the Tank where there shall not be any leakage.

31.5 The test certificates of the routine tests mentioned above at 31.3 and Type & special tests indicated below, conducted by the supplier the tendered equipment or higher rating (both MVA & Voltage rating) distribution transformers at CPRI or any Govt. approved laboratory shall be submitted along with the tender offer, failing which the bid will not be accepted for evaluation. CPRI/Govt. approved laboratory test certificate along with CPRI/Govt. approved laboratory drgs. (Internal and external drgs.) Must accompany the bid.

Type & Special Tests:

- i. Impulse Voltage with stand test
- ii. Temperature rise test
- iii. Short Circuit Test.

32. TEST REPORT:

After all tests have been completed three certificated copies of each test report shall be furnished. Each report shall supply the following information.

- i. Complete identification data including serial number of the transformer.
- ii. Method of application where applied, duration and interpretation of the results for each test.
- iii. Temperature data corrected to 75 °C including ambient temperature.

33. The tenderer shall give the guaranteed technical particulars required in ANNEXURE-I, failing which the tender will be rejected.

34. The tenderer shall submit the detailed dimensional drawing , short circuit, impulse & temperature rise test reports conducted in a govt. approved laboratory for the tendered or higher rating (both MVA & Voltage rating) distribution transformers along with the offer, failing which the offer will not be considered.

35. REJECTION

The transformer may be rejected at the discretion of the purchaser if the test results are not satisfactory and tolerances are exceeded.

36.

36.1 The supplier should guarantee after sales services for minimum period of

one and half years after the Guarantee period.

36.2 The supplier should provide after sales services within 15 days of receipt of intimation from the field engineer in charge of the equipment.

37.

- i) The bidder shall indicate in his offer values of resistance, stray loss, % Impedance, % regulation, no load losses, load losses at rated output, voltage & frequency. These values will be guaranteed MAXIMUM VALUES.
- ii) Losses will be capitalized at the following rates & taken in to account when tenders will be compared as per the guaranteed losses furnished by the bidder in their guaranteed technical particulars but within the specified losses as indicated at clause 20 of the technical specification. Losses quoted beyond losses stipulated as at clause-20 of the technical specification will not be accepted & offer will be rejected:-
 Iron losses (No load losses): Rs. 212.00 per Watt.
 Copper losses (Load Losses): Rs. 127.00 per Watt
- iii) The losses shall be measured during routine tests. If losses will be arrived outside the limits of the guaranteed losses as quoted by the bidder in the Guaranteed technical particulars but will remain within the losses stipulated as at clause-20 of the technical specification, then a financial adjustment shall be made as follows:-
 The successful bidder will be penalized at 2 times the above rates for any loss in excess of the values stated in the bid considering iron & copper losses separately. No bonus shall be payable for the losses which are less than those stated in the bid.
- iv) Also on testing if any of the test results do not match with the values given in the guaranteed technical particulars & as per technical specification, the owner reserves the right to reject the transformer or free to take any other decision.
- v) The owner also reserves the right to retain the rejected transformer & take in to service until the supplier replaces it with a new transformer at no extra cost.

38. Following are the list of annexure enclosed with this technical specification:

1. Annexure-1 - Schedule of technical particulars (to be furnished by the manufacturer)
2. Annexure-II- Format for stage Inspection
3. Annexure-III- Quantity & Delivery schedule

4. Annexure-IV- Calibration status of testing Equipments (To be furnished by the manufacturer)
5. Annexure-V- Check list towards type test reports (To be furnished by the manufacturer)
6. Annexure-VI- Check list for delivery schedule (To be furnished by the manufacturer)

ANNEXURE-I.

SCHEDULE OF TECHNICAL PARTICULARS TO BE FURNISHED BY THE MANUFACTURER

STANDARD FORM OF GUARANTEED TECHNICAL PARTICULARS:-

1. Name of the manufacturer.
2. Service.
3. KVA Rating:-
 - a) H.V. Winding.(KVA)
 - b) L.V. Winding.(KVA)
4. Highest system voltage/Nominal voltage.
 - a) H.V. Winding.(KV)
 - b) L.V. Winding(KV)
5. Rated frequency. (Hz)
6. Number of phases.
7. Connections:-
 - a) H.V. Winding.
 - b) L.V. Winding.
8. Connection symbol (See IS: 2026(Part-IV-1977)).
9. Tappings:-
 - a) Range
 - b) Number of steps for high voltages variation.
10. Reference ambient temperature:-
 - a) Maximum ambient air/temperature. (°C.)
 - b) Maximum daily average ambient air temperature. (°C.)
 - c) Maximum yearly average ambient air temperature. (°C.)
 - d) Minimum ambient air temperature. (°C.)
 - e) Maximum cooling water temperature. (°C.)
11. Type of cooling (See IS-2026(Part-II)/1977.)
12. Temperature rise over ambient temp. (SeeIS-2026(Part-II)/1977)
 - a) Temperature of oil (°C).

- b) Winding. ($^{\circ}\text{C}$).
- 13.
- i) Total loss at rated nominal voltage at normal tap & rated frequency (KW).
 - ii) Stray loss at 75°C (KW).
 - iii) %Regulation.
14. (A) Component losses.
- i) No-load loss at rated nominal voltage and normal frequency (In watts).
 - ii) Load loss at rated current and rated frequency at normal tapping at 75°C . & at extreme taps (In Watts).
- (B)Resistance at normal tap & at 75°C .
- i) H.V (Ohm).
 - ii) L.V. (Ohm).
15. Impedance voltage & percentage Impedance at full rated current at 75°C .at
- a) Normal tap.
 - b) Lowest tap position
 - c) Highest tap position.
16. % Reactance at rated current and rated frequency.
17. No load current at rated nominal voltage and rated frequency and at 50%, 75%, 100%, 110% & 121% voltage & at rated frequency (Amp).
18. Insulation level (See IS-2026(Part-III/1977).
- a) Separate source power frequency voltage with stand
 - i) H.V. Winding (KV rms).
 - ii) L.V. Winding (KV rms).
 - b) Induced over voltage with stand.
 - i) H.V. Winding (KV rms).
 - ii) L.V. Winding (KV rms).

1.2/50 microsecond wave shape Impulse Withstand

 - i) H.V. Winding (KV Peak).
 - ii) L.V. Winding (KV Peak).
 - c) P.I. value.
19. Efficiency:-
- a) Efficiencies at 75°C at unity power factor.
 - i) At full load (%)
 - ii) At $\frac{3}{4}$ full load (%)
 - iii) At $\frac{1}{2}$ full load (%)
 - iv) At 120% of full load (%).
 - b) Efficiency at 75°C and 0.8 P.F. lagging (%)
 - i) At full load.
 - ii) At $\frac{3}{4}$ full load
 - iii) At $\frac{1}{2}$ full load
 - c) Load at which maximum efficiency occurs (%)
 - d) Maximum efficiency (%)

20. Regulation at full load at 75°C
- a) At unity power factor (%)
 - b) At 0.8 power factor loading & lagging (%)
21. Equipment for ONAN cooling:
- i) No. of Radiators on main tank.
 - ii) Make & type
 - iii) No. of tubes/Fins in each radiator.
 - iv) Tube/Fins length(Meter)
 - v) Total radiating surface
 - vi) Thickness of sheets of Tube/Fins(mm)
 - vii) Size of tubes(diainsq.mm)/fins(LxBxH in mm)
 - viii) Loss to be dissipated by Radiators in KW.
 - ix) Dissipation per fin at50°C.
22. Number of coolers or cooler banks per transformer
23. Rating of each cooler or cooler bank.
24. **Terminal arrangement:**
- a) High voltage.
 - b) Low voltage.
 - c) Neutral.
25. **Approximate masses:-**
- a) Core(Kg)
 - b) Winding (Kg).
 - c) Core Coil assembly(Kg)
 - d) Tank, fittings & accessories(Kg)
 - e) Oil(Kg)
 - f) Radiators(Kg)
 - g) Total mass(Kg)
26. **Oil data:-**
- a) Quantity for first filling(Ltr.)
 - b) Grade of oil used.
 - c) Maker's name.
 - d) BDV at the time of filling.
 - e) Type of oil.
27. Approximate tank dimensions for overall dimensions.
- a) Length(mm)
 - b) Breadth(mm)
 - c) Height(mm)
 - d) Thickness of main tank sheets(mm)
 - i. Top plate
 - ii. Bottom plate
 - iii. Side plate.
 - e) Tank inside dimension
 - i. Length
 - ii. Breadth
 - iii. Height
 - f) Tank outside dimension

- i. Length
- ii. Breadth
- iii. Height

28. Dispatch details.

- a) Approximate mass of heaviest package(Kg)
- b) Approximate dimensions of largest package(mm)
 - i. Length
 - ii. Breadth
 - iii. Height

29. Un-tanking height (mm)

30. Clearances:-

- a) Minimum clearance between phases (mm).
 - i. In oil.
 - ii. Out of oil.
- b) Maximum clearance high voltage to tank in oil(mm)
- c) Minimum clearance high voltage to earth in oil(mm)
- d) Minimum clearance height for lifting core & windings from tank(mm)

31. CORE:-

- a) Grade of Core materials used.
- b) Thickness of Core laminations used (mm).
- c) Sp. Loss in watts/Kg. of core materials corresponding to desired flux densities.
(Curve to be furnished along with the bid).
- d) Maximum flux density at highest system voltage & 48.5 c/s frequency (Tesla or W/m²)
- e) Maximum flux density at rated system voltage & rated frequency (Tesla or W/m²)
- f) No-load loss at 110% rated nominal voltage and rated frequency (Watt).
- g) No load current at 110% of nominal voltage & rated frequency
- h) No load current at 121% of nominal voltage & rated frequency
- i) EMF per turn
- j) Core diameter (mm).
- k) Core Window Height(mm)
- l) Core Leg centre(mm)
- m) Total Height of core(mm)
- n) Max width of core
- o) No. of core bolt.
- p) Dia of each core bolt in mm.
- q) Thickness of core bolt insulation(mm)
- r) Total Weight of core(Kg.)
- s) No of Steps
- t) Dimensions of Steps Thickness in mm Width in mm
 - i. Step -1
 - ii. Step-2
 - iii. Step -3
 - iv. Step -4
 - v. Step -5
 - vi. Step -6
 - vii. Step -7

- viii. Step –8
- ix. Step –9
- x. Step –10
- u) Gross core cross sectional area (cm²).
- v) Stacking factor
- w) Net iron section of Limb (cm²).
- x) Net iron section of Yoke (cm²).

32. WINDING:-

	LV	HV	HV
regulating.			
a) Type of winding			
b) Current per phase (Amp.)			
c) Bare conductor size(mm)			
d) Insulated conductor size (mm).			
e) Type of insulation			
f) Thickness of insulation(mm)			
g) Total Conductor cross section(mm ²)			
h) Current density(A/mm ²)			
i) Turns per phase (T).			
j) Coils per limb.			
k) Turns per coil.			
l) Turns per layer.			
m) Layers per coil.			
n) Winding depth.			
o) Coil dia inside.			
p) Coil dia outside.			
q) Length of mean turns.			
r) Resistance at75°C,			
s) Total I ² R loss including stray at 75°C,			
t) Weight of copper with insulations.			
u) Weight of copper without insulations.			

33. Breather:-

- a) Make
- b) Type
- c)
- d) Capacity
- e) Weight of silica gel filled in (grams).

34. Inter layer insulation provided in design for:-

- a) Turn insulation high voltage.
- b) Turn insulation low voltage.
- c) Insulation core to low voltage.
- d) Insulation high voltage to low voltage.
- e) Insulation between winding to top & bottom yoke
- f) In between all layers(mm)
- g) Whether wedges are provided at 50% turns of the coil.

35. Insulation materials.

- a) For conductors(H.V. &LV)
- b) For core.

36. Particulars of bushings:-
- a) Maker's name.
 - b) Type IS-3347/IS-1180.
 - c) Rating as per I.S.
 - d) Dry flash over voltage (KV)
 - e) Wet flash over voltage (KV).

37. I.R. value at 30°C.
- a) HV/E
 - b) LV/E
 - c) HV/LV

38. Polarisation Index:-
- a) HV/E
 - b) LV/E
 - c) HV/LV

Bidders Name:-

Signature :-

Designation :-

Date:-

ANNEXURE-II

FORMAT FOR STAGE INSPECTION

A	WINDING		
Sl. No		L.V.	HV
1.	Conductor Bare mm		
2.	Conductor Insulated (mm)		

3.	Type of Conductor Insulation		
4.	No. of Conductor in parallel.		
5.	Current density (A/mm ²)		
6.	Rated volts per phase (volts).		
7.	Turns per phase (T)		
8.	Type of winding.		
9.	No. of discs (Nos.)		
10	No. of turns/disc.		
.			
11	Inside diameter (mm)		
.			
12	Outside diameter ((mm)		
.			
13	Winding depth (mm)		
.			
14	Winding Length (mm)		
.			
15	Gap between disc (mm)		
.			
16	No. of spacers in one circle.		
.			
17	Size of the spacer (mm)		
.			
18	Length of mean turn in meter.		
.			
19	Weight of winding (Kg/each) · (Weight of winding includes the weight of insulated conductor, spacers, runner & other insulations as has been required to make the windings).		
B. INSULATION.			
1.	Between core & L.V. Winding (Details like thickness (mm), length(mm) type of insulation etc. to be Mentioned).		
2.	Between H.V. & L.V. Winding (Details like thickness (mm), length (mm), type of insulation etc. to be mentioned).		
3.	Between windings to top yoke (Details as above to be mentioned).		
4.	Between windings to bottom yoke (Details as above to be mentioned).		
C	CORE		
1.	Core Diameter in mm=		
2.	Window Height in mm=		

3.	Distance between core leg center in mm=								
4.	Widths of window in mm=								
5.	OTHER PARAMETERS OF CORE:-								
0									
i	No. of Steps	1	2	3	4	5	6	7	8 etc.
ii	Width in Mm								
iii	Stack in Mm								
iv	Sectional area of stack.								
6.	Total gross cross sectional area of the core in mm								
7.	Net core iron area=gross C/S area x 0.97								
8.	Maximum flux density (Bm) in Wb/sq.mm								
9.	Total core weight in Kg by weighment								
10	Thickness of core lamination in mm								
.									
D.	Condition of the Tank:-								
E.	Any other items/tests which have not been covered above and required & indicated in the specification to be carried out by the OPTCL's representative.								

FOR OPTCL

FOR REPAIRER.

Name:

Name of Repairer:

Designation:

Name of Repr.

Designation.

Date:

Date:

Place:

Place:

A N N E X U R E- III.

SCHEDULE OF QUANTITY AND DELIVERY

Sl. No.	Descripti on of materials	Quantity required.	Desired delivery	Destination.	Remarks
1.	2	3.	4	5	6.

1.	250KVA, 33/0.433KV Copper wound Transformer with OLTC.	14 Nos.	Delivery to be completed within 3 months from the date of issue of the Purchase order.	Any Stores/ Sites of OPTCL within State of Odisha.	Requirem ent for 2014-15
2.	250KVA, 33/0.433KV Copper wound Trasns- former with OLTC.	16 Nos.	3 Months from the 01/04/2015.	Any Stores/ Sites of OPTCL within State of Odisha.	Requirem ent for 2015-16
3.	500KVA, 33/0.433KV Copper wound Trans- former with OLTC.	03 Nos.	Delivery to be completed within 3 months from the date of issue of the purchase order.	Any Stores/ Sites of OPTCL within State of Odisha.	Requirem ent for 2014-15
4.	1MVA, 33/0.433KV Copper wound Trasns- former with OLTC.	01 No.	Delivery to be completed within 3 months from the date of issue of the purchase order.	Any Stores/ Sites of OPTCL within State of Odisha.	Requirem ent for 2014-15

Signature of the Tenderer with
seal & date.

N.B:- The data as per the format is to be filled up by the bidder & uploaded as PDF

ANNEXURE-IV

**CALIBRATION STATUS OF TESTING EQUIPMENT AND INSTRUMENTS/
METERS AVAILABLE IN THE FACTORY.**

[FOR CONDUCTING TESTS AS PER CLAUSE 31.4 & 31.5 OF SECTION IV OF TECHNICAL SPECIFICATION]

Name of the Test	Meters & Equipment required for the corresponding test with range, accuracy, make & Sl.No.	Date of Calibration.	Due date of Calibration	Name of Calibrating Agency.	Whether Calibrating Agency is Govt. approved.	Whether documents relating to Govt. approval of the Calibrating Agency furnished.	Whether the meters/ equipment fulfill the accuracy class as per calibration report.	Whether the Calibration Agency has put any limitation towards the use of the particular meter/ equipment. If yes state the limitation.	Whether Green sticker or Blue sticker or Yellow sticker has been affixed on the body of the particular equipment/ meter. State the colour of the affixed sticker.	In spite of imposed limitations whether the particular meter/ equipment can still be used? Justify its use for corresponding during test(s)	Remarks
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.

Signature of the Tenderer with seal & date

N.B:- The data as per the format is to be filled up by the bidder & uploaded as PDF

ANNEXURE-V
CHECK LIST TOWARDS TYPE TEST REPORTS.

Name of the Type Test.	Date of Test.	Name of the Laboratory where the Test has been conducted.	Whether the Laboratory is Government approved.	Whether the Test report is valid	Whether the copy of Test report in complete shape along with drawings etc., furnished or not?	Whether the type tested Transformers full fill the technical requirements as per TS.	Remaks.
1.	2.	3.	4.	5.	6.	7.	8.

Signature of the Tenderer with seal & date.

N.B:- The data as per the format is to be filled up by the bidder & uploaded as PDF

ANNEXURE- VI
CHECK LIST FOR DELIVERY SCHEDULE.

Sl.N o.	Description of the Equipment	Quantity.	Delivery Schedule.

Signature of the Tenderer with seal & date.

N.B:- The data as per the format is to be filled up by the bidder & uploaded as PDF

PART-24
250kVA DIESEL GENERATOR SET

**SPECIFICATION OF 250 KVA DIESEL GENERATORS
SILENT TYPE WITH AMF ARRANGEMENT**

1x250KVA, 380 BHP, 200KW, SILENT AMF Diesel Generator set, 1500 RPM, Water cooled, 6-Cylinders, Diesel engine with AMF control panel, 250 KVA latest make Engine (Reputed & Branded, as per approved make of OPTCL), Alternator and AMF Panel as required for 220/33KV GIS Substation, Talcher, Angul, Odisha.

Diesel engine Specifications and accessories:

AVM with Acoustic enclosure type, Capacity-380 BHP, 6-Cylinders engine cooling system: Water/coolant cooling, Radiator type, 24V, self-starting system with 2-Lead Acid batteries with automatic charging systems etc. Diesel tank-As per manufacturer recommendation but for 350-liter capacity minimum.

Safety Controls:

1. Low Lube oil pressure
2. High water temperature
3. Battery Charging indicator
4. Oil temperature indicators
5. Warning signals with hooters
6. Rpm indicator

Alternator:

1X 250KVA capacity, 415v AC, 3phase, 50Hz, 1500rpm

- a) Numerical type AVR etc.
- b) Control panel accessories
- c) Frequency meter
- d) Pilot lamps
- e) Current transformers
- f) Instrument fuses
- g) Suitable rating ACB (2 Incomers + 1 bus coupler 800A, 4 Pole 50KA rating L&T/Siemens make ACB)
- h) Control cables and other accessories as per manufacturer Electronic KWH meter of 0.2 class acc
- i) ELCB etc.

Engine shall confirm to BS. 649 or IS 10002: 1981, Alternator BS 2613: 1970 or IS

4722:1968 etc. or its latest.

Cables:

(a) Control cable as required

(b) Power cables-3.5 Core X 300 Sq.mm three run for a length of 200 meters
(Total 1200 meters) of PVC armored Aluminum cable.

1. DIESEL ENGINE:

An engine of reputed make, suitable for 1X 250KVA GENSET, inline type, turbo charged, water cooled, electric starting, 1500RPM, four stroke, Multi cylinder diesel engine confirming to BS: 5514/ BS: 649/IS:10000, with 10% overloading for 01 hour in any 12 hours of continuous operation in standard operating conditions. The engine should be able to take 100% load with deration up to 50`C ambient temperature and up to 250m altitude.

2. COOLING SYSTEM:

- Heavy-duty radiator with fan
- Cooling water centrifugal pump
- Coolant Inhibitor

3. EXHAUST SYSTEM:

- Exhaust Gas Turbo Charger
- Exhaust manifolds
- Suitably designed critical grade Nelson silencer complete with thermal insulation and Aluminum cladding.
- Suitably designed exhaust pipe with flexible for carrying the exhaust gases out with minimize back pressure on engine.
- Suitably designed pipe for connecting silencer with stack, so that the back pressure on engine is minimum.
- The engine back pressure should not be more than 2.5 inches of mercury at exhaustpoint.
- Port hole shall be provided as per the emission regulation part- III (CPCB publication).

4. FUEL SYSTEM:

- P.T. Fuel pump
- Fuel Injectors

- Fuel Filters

- Fuel hoses

5. LUBE OIL SYSTEM:

- Lube oil pump

- Lube oil filters

- Super Bypass filter

6. INTAKE AIR SYSTEM:

- Air intake manifold

- Air cleaner with replaceable elements-inner/outer

7. GOVERNER:

- Electronic Governor

- Electronic control panel with digital metering

8. STARTING SYSTEM:

- Electric starter – 24volts DC

- Battery Charging alternator

9. COUPLING ARRANGEMENT:

- Flywheel to suit single bearing alternator

- Flywheel housing

- Inbuilt AM pads to reduce vibrations and eliminate misalignment of engine and alternator

10. SAFTY CONTROLS:

- High water temperature

- Low lube oil pressure

- Over speed, Over Crank

11. ENGINE INSTRUMENT PANEL (ENGINE MOUNTED):

- Starting switch with OFF/START KEY

- Water temperature display

- Lube oil pressure display

- RPM display

- Tachometer with hour meter

12. MANUALS:

- Engine operation and maintenance manual
- Alternator manual with Parts catalogue
- Engine maintenance schedule
- Warranty card
- Engine routine certificate

13. ALTERNATOR:

Synchronous brushless, single bearing alternator, rated at 250KVA, suitable for continuous operation at 1500rpm generating 415volts at 0.8 power factor (lag) suitable for 50Hz, 3 phase, 4 wire system. The alternator shall be self-excited, self-regulated, foot mounted fitted with ball and/or roller bearings. The alternator shall be suitable for tropical climate and shall conform to BS: 2613/ IS: 4722. The class of insulation shall be “H” type.

14. BASE FRAME:

Heavy duty base frame of sturdy design made of M.S. steel with necessary reinforcement and pre-drilled holes, to support the DG set and enclosure.

15. VIBRATION INSULATION:

Specially designed poly bond anti-vibration mounts for vibration insulation should be used between engine/alternator and base frame.

16. FUEL TANK:

Base fuel tank of sheet metal (14SWG), having a capacity of min. 350liters, duly fabricated and painted, complete with drain valve, air vent, level indicator, inlet and outlet connection, locking arrangement to avoid theft of oil, and housed in the base frame.

17. BATTERIES:

Two numbers of batteries or as required for starting of 12 volts, 180 AH each in dry and uncharged condition of reputed make with ignition charging, connecting leads and terminals, provided inside the enclosure.

18. COUPLING AND MOUNTING ARRANGEMENT:

The engine and alternator shall be directly coupled and mounted through in built AVM pads on a heavy-duty steel base frame. There shall be no chance of misalignment of the DG set and the vibrations of the DG set shall not get transmitted to the base-frame and to the enclosure.

19. AMF CONTROL PANEL:

The control panel body shall be fabricated out of 16SWG MS sheet. Panel shall be floor mounted indoor installed, dust and vermin proof. Control wiring shall be 2.5sq.mm shall be used. Cables shall be ferruled for proper maintenance/ checking/ wiring of panel. Detachable cable gland plates are to be provided. This shall be of indoor type.

The panel shall be equipped as follows:

Power Circuit:

- One contactor for mains
- One contactor for DG set interlocked with the mains contactor.

Metering:

- One voltmeter with selector switch
- One ammeter with selector switch
- One frequency meter
- Fuel level gauge

Set of push buttons, selector switches and indicating lamps:

- Continuous sensing of mains and generator voltage
- Auto start and changeover in case of mains failure
- Auto stop and changeover in case of mains resumption
- Three attempt starting
- Over current relay for protection against overloading of DG set

Audio-Video annunciation with engine shutdown for:

- Low lube oil pressure
- High cooling water temperature
- High canopy temperature
- Over current trip

Battery charger consisting of

- Transformer of suitable rating
- Rectifier rate selector switch for “Trickle” or “Boost”
- DC ammeter and DC voltmeter
- An indicating lamp for battery being charged

20. The DG set should comply with the noise limit of 75db(A) at 01m from the enclosure surface and other requirements given in and as per the document “System & Procedure

for Compliance with Noise Limits for Diesel Generator Sets (up to 1000KVA)” issued by CPCB.

21. The diesel engine shall comply with the emission limits given in G.S.R. 371, dated 17.5.02 and G.S.R. 520, dt. 01.7.03 (irrespective of the date of implementation given in the notification) and certified as per emission norms of DOI already notified and or any latest emission note declared by the concerned authority.
22. **ACOUSTIC ENCLOSURE:**
- Acoustic enclosure should be integral part of the Generator set.
 - The acoustic enclosure should be modular construction with the provision to assemble and dismantle easily as per site condition.
 - There should be no protruding parts.
 - The enclosure should be fabricated out of CRCA sheet of 14SWG.
 - The sheet metal components should be dip seven tanks pretreated.
 - To have long life of the enclosure it should be P.P. based powder coated (inside as well outside). All nut and bolt hardware's be Zinc coated or Stainless Steel.
 - Fuel tank at the base of the DG set should have minimum capacity of 350litres. It should be provided with breather, drain plug, fuel gauge meters to indicate fuel level and locking arrangement to avoid theft of oil.
 - There should be provision for filling the fuel from outside as in the case of automobiles with locking arrangement.
 - Battery should be accommodated in a separate tray in the enclosure.
 - There should be provision for drain plugs for draining Mobil oil/ diesel from outside the enclosure.
 - The doors to be provided with high quality EPDN gaskets to avoid leakage of sound.
 - The lockable type of door handles should be provided.
 - Sound proofing of enclosure to be done with high quality rock wool confirming to IS 8183 of minimum 100mm thickness and density of 48-64 kg/m³.
 - The rock wool should further be covered with fiber glass cloth and perforated galvanized MS sheet.
 - Special critical grade silencer is required to be provided to control exhaust noise. (Minimum 25dBA insertion loss)
 - Specially designed anti is required to be provided to meet air requirement for combustion and heat removal. A blower should be used to meet total air requirement, air changes, if required.

- Temperature inside enclosure should not exceed beyond 7°C of ambient temperature.
A provision for emergency shutdown from outside the container should be made.
- Control panel should carry warranty of respective manufacturer for diesel generating set in enclosure.
- The acoustic enclosure shall be rain/ waterproof.

23. FUEL CONSUMPTION:

Engine should be capable of providing fuel consumption of 4 units/lit of diesel, between 80 to 100% load as per BS 5514.

24. INSTALLATION:

The base of the Genset shall be minimum 30cm from the ground level so that the oil/fuel can be drained out easily.

The ground up to 01m around the Genset shall be made of cement concrete platform of mix 1:2:4 (1 cement, 2 Coarse Sand, 4 Stone Chips 20mm).

Guaranteed Technical Particulars

(To be furnished by the bidders)

(A)	Alternator		
-----	-------------------	--	--

1.	Name of manufacturer	:	
2.	Brand Name	:	
3.	Factory Address	:	
4.	Reference Standard	:	
5.	Frequency	:	
6.	Rated Voltage	:	
7.	No. of phases	:	
8.	Rated speed	:	
a)	No load	:	
b)	Rated load	:	
9.	Phase sequence (Viewed from driving end)	:	
10.	Power factor	:	
11.	Rated output (KW/KVA)	:	
12.	Rated Current	:	
13.	Direction of rotation		
14.	Excitation system		
15.	Duty type		
16.	Class of Insulation	:	
17.	Temperature rise	:	
18.	Efficiency at rated voltage and frequency and 0.8 pf	:	
a)	In full load	:	
b)	1/3 load	:	
c)	$\frac{3}{4}$ load	:	
19.	Short circuit rating (Peak)	:	
20.	Over speed limit	:	
21.	Limits of vibration	:	
22.	Type of enclosure	:	
23.	Cooling system	:	
24.	Variation in	:	
a)	Voltage	:	
b)	Frequency	:	
25.	Fly wheel effect of rotating parts	:	
26.	Cyclic irregularity	:	
27.	Irregularity of wave from %	:	

28	Overloads withstand capacity	:	
a)	Momentary	:	
b)	Intermittent	:	
C)	Sustained	:	
29.	Motor starting ability (Current / duration)	:	
	PRIME MOVER	:	
1.	Name of the engine manufacturer	:	
2.	Type of engine	:	
3.	Model and number of cylinders	:	
4.	IS rating	:	
a)	Rating A (With overload)	:	
b)	Rating B (Without overload)	:	
5.	Rating at site condition	:	
6.	Direction of rotation	:	
7.	No. & arrangement of cylinders	:	
8.	Whether two stroke or four stroke	:	
9.	Bore (mm)	:	
10.	Stroke(mm)	:	
11.	Cubic capacity (Litres)	:	
12.	Nominal Compression Ration	:	
13.	BMEP Developed	:	
14.	Mean piston speed	:	
15.	Muffler (silencer) type	:	
16.	Filter type and make	:	
a)	Air	:	
b)	Fuel	:	
c)	Lubricating Oil	:	
17.	Recommended fuel oil specification	:	
18.	Fuel oil tank capacity	:	
19.	Lubricating oil specification	:	

20.	Mode of starting, apparatus required	:	
21.	Specific fuel consumption in Litres per hour under standard reference conditions as per IS. 10000 part- II.	:	
a)	At rated output	:	
b)	At 110% of rated load	:	
c)	At 75% of rated load	:	
d)	At 50% of rated load	:	
e)	At 25% of rated load	:	
22.	Lubricating oil consumption at 100% load in litre/ engine operating hour.	:	
23.	Weight of engine	:	
24.	Overall dimension of engine	:	
25.	Performance curves as per IS-10000(part-VI) 1980 at Standard reference condition.	:	
26.	Accessories on engine as tested and for which a power allowance has been made in the manufacturer's calculation of the site rating.	:	
27.	Voltage of electrical system	:	
28.	List of equipment and tools that will normally be supplied	:	
29.	List of supplementary equipment	:	
30.	Schedule of recommended maintenance and Overhaul periods.	:	
31.	Maximum permissible back pressure in the exhaust system and maximum permissible intake depression.	:	
32.	Method of cooling and capacity of the cooling system with specific rates of water and oil circulation.	:	
33.	The maximum load that can be suddenly applied to the engine while it is running it is at full rated speed, at no load and at	:	

	normal running temperatures.		-
34.	The transient and permanent speed changes that will result from the application of this Load.	:	
35.	The transient and permanent speed rise resulting from full load being thrown off.	:	
36.	The transient and permanent speed change of load, both off and on, by all steps of 25 Percent of the rated full load.	:	
37.	The steady state speed band recovery time to this speed band from all the conditions stated above.	:	
38.	Aspiration	:	
	<u>ACOUSTIC ENCLOSURE</u>	:	
1.	Name of Acoustic Enclosure manufacturer	:	
2.	Enclosure material	:	
3.	Insulation materials	:	
4.	Type of shutters	:	
5.	Overall dimension LXBXH	:	
6.	Noise level to be achieved	:	
7.	Maximum rise in inside temperature above ambient at full load	:	
8	Provision of illumination inside the enclosure	:	
9.	Handling / Lifting facilities	:	

Engine: Cummins / Kirloskar/ Greaves / Caterpillar / Valvo make
 Alternator: Stamford / KEC / Crompton / Valvo make.

L.T Switchgear- L&T / Siemens/ M.G make
 Cable- as per OPTCL vendor.

Relays to be of numerical type.

PART-25
FIRE FIGHTING SYSTEM

FIRE PREVENTION AND FIRE FIGHTING SYSTEM

CLAUSE No.	DESCRIPTION
1.	Intent of specification
2.	Design and construction
3.	Tests
4.	Spare Parts
5.	Horizontal Centrifugal pumps
6.	Diesel Engines
7.	Piping, Valves and Specialities
8.	Air Vessels
9.	Heat detectors, fire detectors and spray nozzles
	Portable and Wheel/ Trolley mounted Fire Extinguishers
10.	Instruments
11.	Electric Motors
12.	Battery & Battery chargers
13.	Control and Annunciation panels

TECHNICAL SPECIFICATION FOR FIRE PREVENTION AND FIRE FIGHTING SYSTEM

1.0 INTENT OF SPECIFICATION:

This section covers the design and performance requirements of the following types of fire protection systems.

- a. Hydrant System
- b. High Velocity Water (HVW) Spray System
- c. Fire Detection and Alarm System
- d. Portable Fire Extinguishers
- e. Wheel/ Trolley Mounted Fire Extinguishers

It is not the intent to completely specify all details of Design and Construction. Nevertheless, the System Design and Equipment shall conform in all respects to high standard of engineering, design, and workmanship and shall be capable of performing in continuous commercial operation in a manner acceptable to the Owner. The System Design shall also conform to IS/TAC/NFPA /OISD norms.

The Scope of Work include complete Earthwork (i.e. excavation, backfilling etc.) for the entire buried piping for the system, value pits and pipe supports for buried, entrenched and over ground piping.

The equipment offered shall comply with the relevant Indian Standards unless specified otherwise. The equipment conforming to any other approved International Standards shall meet the requirement called for in the latest revision of relevant Indian Standard or shall be superior. The Deluge Valves, HVW Spray Nozzles and Quartzoid Bulb Detectors shall have the approval of any of the following agencies

- a) UL of USA
- b) FM of USA
- c) LPCB of UK or
- d) VDS of Germany.

Ambient temperature for design of all equipment shall be considered as 50 degrees Centigrade.

The successful bidder shall prepare detailed layout and piping drawing based on this drawing and other drawings such as road, drainage, cable trench, switch yard layout, etc. as furnished by the Employer during detailed engineering. The typical drawings for location of fire detectors and fire extinguishers in control cum administrative building is also enclosed and shall be followed for execution.

Equipment under the fire protection system should be supplied from the suppliers approved by OPTCL (A list of approved vendors is enclosed at Appendix-II). All equipment shall conform to the data sheets attached in APPENDIX-I and/or relevant subsections/clauses of this specification. In case of contradiction between data specification sheets and relevant subsections/clauses, then stipulations of the data sheets will prevail.

2.0 DESIGN AND CONSTRUCTION:

HYDRANT SYSTEM:

Hydrant System of Fire Protection essentially shall consists of a large network of pipe, both underground and over ground which feeds pressurized water to a number of Hydrant Valves, Indoor (if applicable) as well as Outdoor. These Hydrant Valves shall be located at strategic locations near Buildings & Transformers. Hose Pipes of suitable length and fitted with Standard Accessories like Branch Pipes, Nozzles etc., are to be kept in Hose Boxes. In case of emergency, these Hoses shall be coupled to the respective Hydrant Valves through instantaneous Coupling and jet of water shall be directed on the Equipment on Fire. Hydrant Protection shall be provided for the following areas below. At least one Hydrant Post shall be provided for every 60metres of external wall measurement of Buildings.

- a) Control room building
- b) L.T. Transformer area.
- c) Fire Fighting pump House.
- d) Stores
- e) Transformers

A Warning Plate shall be placed near the Hydrant Points for the Transformers and the pump in 220kV substations to clearly indicate that water shall be sprayed only after ensuring that the power to the Transformer which is on fire is switched off and there are no Live Parts within 20 metres of distance from the personnel using the Hydrant.

HIGH VELOCITY WATER (HVW) SPRAY SYSTEM:

H.V.W. spray type fire protection essentially consists of a network of projectors and an array of heat detectors around the Transformer to be protected. On operation of one or more of heat detectors, Water under pressure is directed to the projector network through a Deluge valve from the pipe network laid for this system. This shall be provided for transformer in the substation. Wet detection initiation system shall be employed for automatic operation. The system shall be designed in such a way that the same can be extended to protect additional Transformer to be installed in future. However, for the purpose of design it shall be assumed that only one Transformer will be on fire. The main header pipe size in the yard shall be 250mmNB and the branch to the equipment (shall not be more than 20metres length) shall be of the same size as of deluge valve.

The Electrical clearance between the Emulsifier system pipe work and live parts of the protected equipment shall not be less than the values given below:

- | | |
|-------------------|---------|
| 1. 245 kV bushing | 2150 mm |
| 2. 52 kV bushing | 630 mm |
| 3. 36 kV bushing | 320 mm |

System shall be designed in such a way that the Water pressure available at any spray nozzle shall be between 3.5 bar and 5.0 bar and shall be demonstrated through hydraulic calculations. Water shall be applied at a minimum rate of 10.2 LPM/M² of the surface area of the transformer including radiator, conservator, oil pipes, bushing turrets, etc. (including bottom surface for transformer). The nozzle arrangement shall ensure direct impingement of water on all exterior surfaces of transformer tank, bushing turrets, conservator and oil pipes, except underneath the transformer, where horizontal spray may be provided.

DELUGE VALVE:

Deluge Valve shall be water pressure operated manual reset type. The Deluge valve shall be closed water tight when water pressure in the heat detector pipe work is healthy and the entire pipe work shall be charged with water under pressure up to the inlet of the Deluge valve. On fall of water pressure due to opening of one or more heat detectors, the valve shall open and water shall rush to the spray water network through the open Deluge valve. The valves shall be manually reset to initial position after completion of operation. Each Deluge Valve shall be provided with a water motor gong which shall sound an alarm when water after passing through the Deluge valve, is tapped through the water motor. Each Deluge valve shall be provided with a local panel with provision of opening of Deluge valve from local and remote from control room/ remote centre. In addition to this, each valve shall be provided with local operation latch. Deluge valves of 100mmNB size shall be used if the flow requirement is $\leq 200\text{m}^3/\text{hr}$ and 150mmNB size shall be used for flow requirement $>200\text{m}^3/\text{hr}$. Test valves shall simulate the operation of Deluge valves and shall be of quick opening type. The general construction shall conform to requirements under clause no.7.00.00 for piping, valves and specialties.

HIGH VELOCITY SPRAY NOZZLES (PROJECTORS):

High velocity spray system shall be designed and installed to discharge water in the form of a conical spray consisting of droplets of water travelling at high velocity, which shall strike the burning surface with sufficient impact to ensure the formation of an emulsion. At the same time the spray shall efficiently cut off oxygen supply and provide sufficient cooling.

Minimum set point of the heat detectors used in the HVW spray system shall be 79°C. The optimum rating shall, however, be selected by the Bidder, keeping in mind the maximum and minimum temperature attained at site.

Fire Detection and alarm System. This system shall be provided for control room building and Switchyard panel rooms of substation. Suitable fire detection system using smoke detectors and/or heat Detectors shall be provided for the entire building, including corridor and toilets. Fire detectors shall be located at strategic locations in various rooms of the building. Each Switchyard panel room shall be considered a separate zone. Adequate number of extra zones shall be provided for Switchyard panel rooms for future bays identified in Single line diagram of the substation. The operation of any of the fire detectors/ manual call point should result in the following:

1. A visual signal exhibited in the annunciation panels indicating the area where the fire is detected.
2. An audible alarm sounded in the panel, and
3. An external audible alarm sounded in the building, location of which shall be decided during detailed engineering.
4. If the zone comprises of more than one room, a visual signal shall be exhibited on the outer wall of each room.

Each zone shall be provided with two zone cards in the panel so that system will remain healthy even if one of the cards becomes defective. Coverage area of each smoke detector shall not be more than 80 m² and that of heat detectors shall not be more than 40 m². Ionisation type smoke detectors shall be provided in all areas except pantry room where heat detectors shall be

provided. If a detector is concealed, a remote visual indication of its operation shall be provided. Manual call points (Break glass Alarm Stations) shall be provided at strategic locations in the control room building. All cabling shall be done through concealed conduits.

Cables used should be exclusively for fire detection and alarm system and shall be 2Cx1.5sq.mm Cu. cables. Un-armoured PVC insulated FR cables conforming to IS 1554 (Part 1) shall be used.

Portable and Wheel/ Trolley mounted Fire Extinguishers

Portable Fire Extinguishers Adequate number of portable fire extinguishers of pressurised water, dry chemical powder, and Carbon dioxide type shall be provided in suitable locations in control room building and FFPH building as indicated in the drawing. In addition to this one (1) CO₂ type fire extinguisher of 4.5kg capacity shall be provided for each Switchyard panel room. These extinguishers will be used during the early phases of fire to prevent its spread and costly damage. The design, construction & testing of portable fire extinguishers shall meet the requirements as per clause 10.

Wheel/ Trolley mounted Fire Extinguishers Wheel/Trolley mounted Mechanical foam type fire extinguishers of 50litre capacity, conforming to IS:13386, shall be provided for the protection of the following:

1. Two (2) nos. for one 220/33kV transformer.
2. LT transformers in the substation. One (1) no. For each transformer. The design, construction & testing of Mechanical foam type 50 litre capacity shall meet the requirements of relevant IS Codes and clause 10 of this specification.

Water Supply System, Water for hydrant & HVW system shall be supplied by one electrical motor driven pump of rated capacity 410m³/hr. at 70MWC head, with another pump of same capacity, driven by diesel engine, shall be used as standby. Water storage tank with two compartments of adequate capacity shall be provided. Pumps shall work under positive suction head. Annunciators of the hydrant & HVW spray systems shall be provided in fire water pump house and repeated in control room. The outdoor piping for the system in general shall be laid above ground on concrete pedestals with proper supporting arrangement. However, at road/rail crossings, in front/access of buildings, places where movement of cranes/vehicles is expected and at any other place where above ground piping is not advisable, the pipes shall be laid underground. Such locations shall be finalised during detailed engineering. The whole system will be kept pressurised by providing combination of air vessel and jockey pump of 10.8M³/hr. capacity at 80MWC. The capacity of air vessel shall not be less than 3m³. Minor leakage will

be met by Jockey pump. One additional jockey pump shall be provided as standby. All pumps shall be of horizontal centrifugal type. Pumps and air vessel with all auxiliary equipment will be located in firewater pump house. A pressure relief valve of suitable rating shall be provided in water header to release excess pressure due to atmospheric temperature variations. Operation of all the pumps shall be automatic and pumps shall be brought into operation at pre-set pressure. Fire pumps shall only be stopped manually. Manual start/stop provision shall be provided in local control panel.

The general design of the firefighting pump sets shall meet the requirements under clauses no.5 for Horizontal centrifugal pumps, no.6 for Diesel engines and no.12 for Electrical motors.

Each pump shall be provided with a nameplate indicating suction lift/delivery head, capacity and number of revolutions per minute.

Design, construction, erection, testing and trial operation of piping, valves, strainers, hydrant valves, hoses, nozzles, branch pipes, hose boxes, expansion joints etc. shall conform to the requirements of clause no. 7.

Instrumentation and Control System

All instruments like pressure indicators, differential pressure indicators, pressure switches, level indicators, level switches, temperature indicators, alarms and all other instruments and panels as indicated in the specification and drawings and those needed for safe and efficient operation of the whole system shall be furnished according to the requirements of clause 11. Pump running/ fails to start signal shall be taken from the pressure switch immediately after the discharge of the pump.

Control Panel Power feeder for motors will be from switchgear board located in control building but control supply for all local control panels, annunciation panels, battery charger units, space heaters etc. shall be fed from the AC and DC distribution boards located in pump house. These AC & DC distribution boards will be fed from the switchgears and DCDBs located in control building.

a) Panel for motor driven fire water pump The panel shall be provided with the following:

- | | | |
|----|---|--------|
| 1. | TPN switch | 1 Nos. |
| 2. | Auto/manual switch | 1 Nos. |
| 3. | Start/Stop Push buttons
with indication lamp | 1 Set |
| 4. | DOL starter with | 1 Set |

- | | | |
|----|------------------------------------|--------|
| | thermal O/L relay | |
| 5. | Indicating lamp showing power ON | 1 Set |
| 6. | Indication lamp with drive ON/OFF | 1 Set |
| 7. | Indication lamp showing Motor Trip | 1 Nos. |

Main power cable from breaker feeder of main switchboard shall be terminated in this panel and another cable shall emanate from this panel which shall be terminated at motor terminals.

- | | | |
|----|--------------------------------|--------|
| b) | Panel for Two nos. Jockey Pump | 1 Nos. |
|----|--------------------------------|--------|

The panel shall be provided with the following:

- | | | |
|----|---|----------------------------|
| 1. | Fuse-switch unit for Jockey pumps | 1 Set for each pump |
| 2. | Auto/manual switch for | 1 Nos. for each pump. |
| 3. | Selector switch for selecting either jockey pump | 1 Nos. |
| 4. | D.O.L. starter with overload relay self-resetting type, for all the drives. | 1 Nos. each |
| 5. | Start/stop push button for Pump with indication lamp with pad-locking arrangements in stop position | 1 Set for each pump Jockey |
| 6. | Indication lamp for trip indication | 1 Nos. each for pump |

- | | | |
|----|---|--------|
| c) | Panel for 2 Nos. battery charger & Diesel Engine driven fire water pump | 1 Nos. |
|----|---|--------|

The panel shall be provided with the following:

- | | | |
|----|--|-------|
| 1. | Auto/Manual switch for Diesel Engine driven pump | 1 No. |
| 2. | Start/Stop push buttons with indication lamp | 1 Set |
| 3. | Indicating lamp showing | 1 Set |

- drive ON/OFF
- | | | |
|----|---|------------|
| 4. | D.C. Voltmeter/Ammeter in the battery charger circuit | 1 No. each |
| 5. | Battery charger will be as per specification described | 1 Set |
| 6. | Selector switch for selecting either of battery chargers for the battery sets. | 1 No. |
| 7. | Selector switch for selecting either set of batteries for Diesel engine starting. | 1 No. |
| 8. | Selector switch for boost charging/Trickle charging of battery set. | 1 Set |

d) Individual local control panel is to be considered for each transformer deluge system wherever these equipment are envisaged. This panel shall contain push buttons with indicating lamps for spray ON/OFF operation in the valve operation circuit. Push buttons shall be concealed behind glass covers, which shall be broken to operate the buttons. Provision shall be made in the panel for the field signal for the annunciations such as spray ON and fire in the Transformer. A signal for spray ON shall also be provided in the control room fire alarm panel for employer's event logger. Remote operation facility to open the Deluge valve from control room/ remote centre shall also be provided.

Annunciation Panels:

a) Location: Fire Water Pump House

- i) Indicating lamps showing power supply "ON".
- ii) Annunciation windows complete with buttons. Details are as follows:

<u>Sl.No.</u>	<u>Description</u>	<u>Number</u>
1.	Electric motor driven fire water pump running	1
2.	Electric motor driven fire water pump fails	1

	to start	
3.	Diesel engine driven fire water pump running.	1
4.	Diesel engine driven water pump fails to start	1
5.	Jockey pump-1 running	1
6.	Jockey pump-1 fails to start	1
7.	Jockey pump-2 running	1
8.	Jockey pump-2 fails to start	1
9.	Fire in Transformer	1
10.	Deluge system operating for Transformer equipment	1
11.	Header pressure low	1
12.	Fire in smoke detection system zone (Common Fire Signal)	1
13.	Water storage tank water level low	2
14.	High speed diesel tank level low	1
15.	Spare	1

b) Location 220kV Control Room:

- i) Indication lamp showing power supply 'ON'
- ii) Provision shall be made in the panel for a signal for spray ON for each Transformer for owner's use for event logger.
- iii) Each Switchyard panel room shall be considered as separate zone for fire detection and alarm system.
- iv) Following annunciations shall be provided.

S.NO	DESCRIPTION	NUMBER
1	Fire in Transformer	1 for each equipment
2	Diesel Engine driven Fire Water Pump 'IN OPERATION'	1

3	Motor driven Fire Pump 'IN OPERATION'	1
4	Jockey Pump 'IN OPERATION'	1
5	Fire Fighting Water Storage Tank Level 'LOW'	2
6	Fire / Fault (Zone Alarm Module)	1 + 1 (duplicate) for each Zone as applicable
7	Spare Windows complete in all respect, with Relays	10
8	Spare Zone Alarm Modules	Number of future A/C Kiosks required for the Bays identified as per SLD

- c) Each Annunciation Panel shall be provided with a Hooter.
- d) Indication for fault in respective areas shall also be provided. Each Zone Alarm Module shall exhibit 'FIRE' and 'Fault' conditions separately.

The Control and Interlock System for the Fire Protection System shall meet the following requirements:

1. Electric Motor Driven Fire Water Pump:

Pump should start automatically when the System Header Pressure is 'Low'. Pump should be stopped manually only. Pump should also be started manually if required from Local Panel.

2. Diesel Engine Driven Standby Pump:

The Pump should automatically start under any of the following conditions:

- System Header Pressure 'Low'
 - Electric Motor operated Fire Water Pump 'Fails to Start'
- Pump should be stopped manually only. Pump should also be started manually if required from the Local Control Panel. The Battery Set, which is connected for starting of Diesel Engine, shall not be subjected to Boost Charge.

3. Jockey Pump:

It shall be possible to select any one of the Jockey Pumps as Main and the other as Standby. Main Jockey Pump shall start automatically when water pressure in header falls below the set value. If the Main Jockey Pump fails to start then the Standby should start. Jockey Pump shall stop automatically when the pressure is restored to its normal value.

Manual 'Starting' / 'Stopping' shall be possible from the Local Control Panel.

3.0 TESTS:

SHOP TESTS:

Shop Tests of all Major Equipment, Centrifugal Pumps, Diesel Engines, Electrical Drive Motors, Piping, Valves and Specialties, Pressure and Storage Vessels, MCC, Electrical Panels, Controls,

Instrumentation etc., shall be conducted as specified in various Clauses and as per applicable Standard / Codes.

Shop Tests shall include all Tests to be carried out Bidder's Works; Works of his Sub -Contractor and at Works where Raw Materials supplied for manufacture of Equipment are fabricated. The Tests to be carried out shall include but not be limited to the Tests described as follows: -

- a) Materials Analysis and Testing
- b) Hydrostatic Pressure Test of all Pressure Parts, Piping, etc.,
- c) Dimensional and Visual Check
- d) Balancing Test of Rotating Components
- e) Response of Heat / Smoke Detectors
- f) Performance Characteristic of HVW Spray Nozzles (Projectors)
- g) Flow Rate and Operational Test on Flow Control Valves
- h) Operational Test of Alarm Valve (Water - Motor Gang)
- i) Calibration Test of Instruments and Tests on Control Panel
- j) Destruction/ Burst Test on 2% or minimum one (1) number of Hoses and Portable Type Fire Extinguishers for each type as applicable Any fraction number shall be counted as next higher integer
- k) Performance Test on Fire Extinguishers as required in the Code

In the absence of any Code/ Standard, equipment shall be tested as per mutually agreed procedure between the Supplier and the Owner.

A comprehensive Visual and Functional Check for Panels would be conducted and will include a thorough check up of Panel dimensions, material of construction, Panel finish, compliance with tubing and wiring specification, quality of workmanship, proper tagging, and locations of instruments/accessories. The Wiring Check shall be complete point to point ring out check for agreement with installation drawing and equipment Vendor prints off the complete system and an inspection of all field connection terminals and levelling.

All Test Certificates and Reports shall be submitted to the Owner for approval.

The Owner's representative shall be given full access to all Tests. The Manufacturer shall inform the Owner allowing adequate time so that if Owner desires, his representatives can witness the Test.

PRE - COMMISSIONING TESTS:

General:

- a) All Piping and Valves, after installation will be tested hydraulically at a pressure of 16 kg / cm² for a period of 30 minutes to check against leak tightness
- b) All Manually Operated Valves / Gates shall be operated throughout 100% of the travel and these should function without any trouble whatsoever, to the satisfaction of the Owner.
- c) All Pumps shall be run with the specified fluid from shut off condition to valve wide - open condition. Head developed will be checked from the discharge pressure gauge reading. During the Test, the Pumps and drives shall run smoothly without any undue vibration, leakage through gland, temperature rise in the bearing parts, noise, flow pulsation etc.,
- d) All Pressure Vessels should be tested hydraulically at the specified Test Pressure, singly or in the System.
- e) Painting shall be checked by dry type thickness gauges

- f) Visual Check on all structural components, welding, painting etc., and if doubt arises, these will be tested again
- g) All Test Instruments and equipment shall be furnished by the Bidder to the satisfaction of the Owner.
- h) Automatic starting of all the Fire Pumps by operating the Test Valves
- i) Automatic operation of the Jockey Pump
- j) Operation of the Deluge Valve by breaking a Detector as well as manual and remote operation of the Deluge Valve
- k) Operation of entire Annunciation System
- l) Replacement of fused/damaged Quartzoid Bulb Detectors during the test shall be responsibility of the Bidder.

After Erection at Site, the complete HVW Spray Protection and Hydrant System shall be subject to tests to show satisfactory performance for which detailed procedure shall be submitted for Owner's approval. Full Flow Test with water shall be done for the system piping as a means of checking the nozzles layout, discharge pattern and coverage, any obstructions and determination of relation between design criteria and actual performance also to ensure against clogging of the smaller piping and the discharge pipes by foreign matter carried by the water. Rigidity of Pipe Supports shall also be checked during the water flow.

All the Detectors installed shall be tested for actuation by bringing suitable source of heat/smoke near the Detector and creating a stream of hot air/smoke over the Detector. The exact procedure of this Test shall be detailed out to the Owner by the Successful bidder.

4.0 SPARE PARTS:

The Contractor shall indicate in his scope of supply all the mandatory spares in the relevant schedules.

5.0 HORIZONTAL CENTRIFUGAL PUMPS:

This clause covers the design, performance, manufacturing, construction features and testing of horizontal centrifugal pumps used for the purpose of fire fighting.

The materials of the various components shall conform to the applicable IS/BS/ASTM/DIN Standards.

In case of any contradiction with the aforesaid standards and the stipulations as per the technical specification as specified hereinafter, the stipulations of the technical specification shall prevail.

General Performance Requirements

The pump set shall be suitable for continuous operation at any point within the "Range of operation".

Pumps shall have a continuously rising head capacity characteristics from the specified duty point towards shut off point, the maximum being at shut off.

Pumps shall be capable of furnishing not less than 150% of rated capacity at a head of not less than 65% of the rated head. The shut off head shall not exceed 120% of rated head. Range of operation shall be 20% of rated flow to 150% of rated flow.

The pump-motor set shall be designed in such a way that there is no damage due to the reverse flow through the pump which may occur due to any mal-operation of the system.

Drive Rating:

The drive rating shall not be less than the maximum power requirement at any point within the "Range of Operation" specified. During starting under reverse flow condition, the motor shall be capable of bringing the pump to rated speed at normal direction with 90% rated voltage at motor terminals.

Pump set along with its drive shall run smooth without undue noise and vibration. Acceptable peak to peak vibration limits shall generally be guided by Hydraulic Institute Standards.

The Contractor under this specification shall assume full responsibility in the operation of the pump and drive as one unit.

Design & Construction.

Pump casing may be axially or radially split. The casing shall be designed to withstand the maximum pressure developed by the pump at the pumping temperature.

Pump casing shall be provided with adequate number of vent and priming connections with valves, unless the pump is made self-venting & priming. Casing drain, as required, shall be provided complete with drain valves.

Under certain conditions, the pump casing nozzles will be subjected to reactions from external piping. Pump design must ensure that the nozzles are capable of withstanding external reactions not less than those specified in API-610.

Pump shall preferably be of such construction that it is possible to service the internals of the pump without disturbing suction and discharge piping connections.

Impeller:

The impeller shall be secured to the shaft and shall be retained against circumferential movement by keying, pinning or lock rings. On pumps with overhung shaft impellers shall be secured to the shaft by an additional locknut or cap screw. All screwed fasteners shall tighten in the direction of normal rotation.

Wearing Rings:

Replaceable type wearing rings shall be furnished to prevent damage to impeller and casing. Suitable method of locking the wearing ring shall be used.

Shaft:

Shaft size selected shall take into consideration the critical speed, which shall be at least 20% away from the operating speed. The critical speed shall also be at least 10% away from runaway speed.

Shaft Sleeves:

Renewable type fine finished shaft sleeves shall be provided at the stuffing boxes/mechanical seals. Length of the shaft sleeves must extend beyond the outer faces of gland packing or seal and plate so as to distinguish between the leakage between shaft & shaft sleeve and that past the seals/gland. Shaft sleeves shall be securely fastened to the shaft to prevent any leakage or loosening. Shaft and shaft sleeve assembly should ensure concentric rotation.

Bearings:

Bearings of adequate design shall be furnished for taking the entire pump load arising from all probable conditions of continuous operation throughout its "Range of Operation" and also at the shut-off condition. The bearing shall be designed on the basis of 20,000 working hour's minimum for the load corresponding to the duty point. Bearings shall be easily accessible without disturbing the pump assembly. A drain plug shall be provided at the bottom of each bearing housing.

Stuffing Boxes:

Stuffing box design shall permit replacement of packing without removing any part other than the gland. Stuffing boxes shall be sealed/cooled by the fluid being pumped and necessary piping, fittings, valves, instruments, etc. shall form an integral part of the pump assembly.

Shaft Couplings:

All shafts shall be connected with adequately sized flexible couplings of suitable design. Necessary guards shall be provided for the couplings.

Base Plates & Sole Plate:

A common base plate mounting both for the pump and drive shall be furnished. The base plate shall be of rigid construction, suitably ribbed and reinforced. Base plate and pump supports shall be so constructed and the pumping unit so mounted as to minimise misalignment caused by mechanical forces such as normal piping strain, hydraulic piping thrust etc. Suitable drain taps and drip lip shall be provided.

Material of Construction:

All materials used for pump construction shall be of tested quality. Material of construction of the major parts of the pumps shall be as given below:

- | | | |
|----|--------------|---------------------------------|
| a) | Casing | Casting Grade FG: 260 of IS 210 |
| b) | Impeller | Bronze Grade LTB 2 of IS:318 |
| c) | Wearing ring | Bronze Grade LTB 2 of IS:318 |

- | | | |
|----|--------------|--|
| d) | Shaft | Grade 40C8 of IS 1570
(Part 2, section 1.): 1979. |
| e) | Shaft sleeve | Bronze Grade LTB 2 of IS:318 or
Chrome steel 07Cr13 of IS
1570 (part 5) :1985. |
| f) | Stuffing box | 2.5% Nickel CI Grade FG 260 of
IS:210 |
| g) | Gland | --- do --- |

Balancing:

All rotating components shall be statically and dynamically balanced at shop. All the components of pumps of identical parameters supplied under this specification shall be interchangeable.

Tests and Inspection.

The manufacturer shall conduct all routine tests required to ensure that the equipment furnished conform to the requirements of this specification and are in compliance with the requirements of applicable Codes and Standards. The particulars of the proposed tests and the procedures for the tests shall be submitted to the Employer/Engineer for approval before conducting the tests.

Where stage inspection is to be witnessed by Employer, in addition to above, the Bidder shall submit to the Employer/Engineer at the beginning of the contract, the detailed PERT-Chart showing the manufacturing programme and indicating the period where Employer or his authorised inspecting agency are required at the shop.

Material of Construction:

All materials used for pump construction shall be of tested quality. Materials shall be tested as per the relevant standards and test certificates shall be made available to the Employer/Engineer.

Where stage inspection is to be witnessed by Employer, all material test certificates shall be correlated and verified with the actual material used for construction before starting fabrication, by Employer's Inspector who shall stamp the material. In case mill test certificates for the material are not available, the Contractor shall carry out physical and chemical tests at his own cost from a testing agency approved by the Employer, as per the requirements of specified material standard. The samples for physical and chemical tests shall be drawn up in presence of Employer's inspector who shall also witness the tests.

Shaft shall be subjected to 100% ultrasonic test and machined portion of the impeller shall be subject to 100% DP test. On finished shaft DP test will also be carried out.

Hydraulic test at shop:

All pressure parts shall be subjected to hydraulic testing at a pressure of 150% of maximum pressure generated by the pump at rated speed or 200% of total dynamic head whichever is higher, for a period not less than one (1) hour.

Performance test at shop:

Pumps shall be subjected to routine tests to determine the performance of the pumps. These tests shall be conducted in presence of Employer/Engineer's representative as per the requirements of the Hydraulic Institute Standards/ASME Power Test Code PTC 8.2/BS-599/I.S.S., latest edition. Routine tests shall be done on all the pumps.

Performance tests shall be conducted to cover the entire range of operation of the pumps. These shall be carried out to span 150% of rated capacity up to pump shut-off condition. A minimum of five combinations of head and capacity are to be achieved during testing to establish the performance curves, including the design capacity point and the two extremities of the Range of operation specified.

Tests shall preferably be conducted along with the actual drives being supplied.

The Bidders shall submit in his proposal the facilities available at his works to conduct performance testing. If because of limitations of available facilities, a reduced speed test or model test has to be resorted to establish pump performance, the same has to be highlighted in the offer.

In case of model testing, the stipulations of latest edition of Hydraulic Institute Standards shall be binding. Prototype or model tests, however, shall be conducted with the suction condition identical to the field conditions i.e. sigma values of prototype and model is to be kept same.

Prior to conducting model testing, calculations establishing model parameters, sizes and test procedure will be submitted to Employer/Engineer for approval.

All rotating components of the pumps shall be subjected to static and dynamic balancing tests.

The Employer or his authorised representative shall have full access to all tests. Prior to performance tests, the Contractor shall intimate the Employer allowing adequate time so that if the Employer so desires, his representative can witness the test.

Report and test certificates of the above tests shall be submitted to the Employer/Engineer for approval.

Pre commissioning tests.

After installation, pumps offered may be subjected to testing at field also by Employer. If the performances at field are not found to meet the requirement, then the equipment shall be rectified by the Contractor without any extra cost. Prior to performance testing, the procedure

for such tests will be mutually agreed between Employer and Contractor. The Contractor shall furnish all necessary instruments, accessories and personnel for testing. Prior to testing, the calibration curves of all instruments and permissible tolerance limit of instruments shall be mutually agreed upon.

6.0 DIESEL ENGINES:

This Clause covers the design, performance, manufacturing construction features and testing of compression ignition diesel engines, used primarily for driving centrifugal pumps, used for the purpose of firefighting.

Design and Construction General:

The diesel engine shall be of multi cylinder type four-stroke cycle with mechanical (airless) injection, cold starting type.

The continuous engine brake horse power rating (after accounting for all auxiliary power consumption) at the site conditions shall be at least 20% greater than the requirement at the duty point of pump at rated RPM and in no case, less than the maximum power requirement at any condition of operation of pump.

Reference conditions for rated output of engine shall be as per IS: 10000, part II or ISO: 3046, part I.

The engine shall be designed with regard to ease of maintenance, repair, cleaning and inspection.

All parts subjected to substantial temperature changes shall be designed and supported to permit free expansion and contraction without resulting in leakage, harmful distortion or misalignment.

Starting

The engine shall be capable of both automatic and manual start. The normal mode of starting is automatic but in the event of failure of automatic start or at the discretion of the operator, the engine can be started manually from the LCP. Since the fire pumping unit driven by the diesel engine is not required to run continuously for long periods and the operation will not be frequent, special features shall be built into the engine to allow it to start within a very short period against full load even if it has remained idle for a considerable period.

If provision for manual start (cranking) is provided, all controls/ mechanisms, which have to be operated during the starting process, shall be within easy reach of the operator.

Automatic cranking shall be effected by a D.C. motor having high starting torque to overcome full engine compression. Starting power will be supplied from either of the two (2) sets of storage batteries. The automatic starting arrangement shall include a 'Repeat Start' feature for

3 attempts. The battery capacity shall be adequate for 3 (three) consecutive starts without recharging with a cold engine under full compression.

The batteries shall be used exclusively for starting the diesel engine and be kept fully charged all the time in position. Arrangement for both trickle and booster charge shall be provided. Diesel engine shall be provided with two (2) battery charger units of air-cooled design. The charger unit shall be capable of charging one (1) set of battery at a time. Provision shall, however, be made so that any one of the charger units can be utilised for charging either of the two (2) batteries.

For detail design of battery and battery charger, sub- section Electrical may be referred to.

Governing System:

The engine shall be fitted with a speed control device, which will control the speed under all conditions of load.

The governor shall offer following features:

- a) Engine should be provided with an adjustable governor capable of regulating engine speed within 5% of its rated speed under any condition of load between shut-off and maximum load conditions of the pumps. The governor shall be set to maintain rated pump speed at maximum pump load.
- b) Engine shall be provided with an over speed shut- down device. It shall be arranged to shut-down the engine at a speed approximately 20% above rated engine speed and for manual reset, such that the automatic engine controller will continue to show an over speed signal until the device is manually reset to normal operating position (Vol.II, NFPA, 1978).

The governor shall be suitable for operation without external power supply.

Fuel System:

The diesel engine will run on High Speed Diesel.

The engine shall be provided with fuel oil tank of 250 litres capacity. The fuel oil tank shall preferably be mounted near the engine. No fuel oil tank will be provided by the Employer.

The fuel oil tank shall be of welded steel constructed to relevant standards for mild steel drums. The outlet of the tank shall be above the inlet of fuel injection pump of the diesel engine to ensure adequate pressure at suction of injection pump.

The fuel oil tank shall be designed in such a way that the sludge and sediment settles down to the tank bottom and is not carried to the injection pump. A small sump shall be provided and fitted with drain plug to take out sludge/sediment and to drain oil. Adequate hand holes (greater than 80 mm size) shall be provided to facilitate maintenance.

Pipeline carrying fuel oil shall be gradually sloped from the tank to the injection

pump. Any valve in the fuel feed pipe between the fuel tank and the engine shall be placed adjacent to the tank and it shall be locked in the open position. A filter shall be incorporated in this pipeline, in addition to other filters in the fuel oil system. Pipe joints shall not be soldered and plastic tubing shall not be used. Reinforced flexible pipes may also be used.

The complete fuel oil system shall be designed to avoid any air pocket in any part of the pipe work, fuel pump, sprayers/injectors, filter system etc. No air relief cock is permitted. However, where air relief is essential, plugs may be used.

A manual fuel pump shall be provided for priming and releasing of air from the fuel pipelines.

Lubricating Oil System:

Automatic pressure lubrication shall be provided by a pump driven by the crank shaft, taking suction from a sump and delivering pressurized oil through cooler and fine mesh filters to a main supply header fitted in the bed plate casing. High pressure oil shall be supplied to the main and big end bearings, cam-shaft bearings, cam-shaft chain and gear drives, governor, auxiliary drive gears etc. Valve gear shall be lubricated at reduced pressure through a reducing valve and the cams by an oil bath.

Cooling Water System:

Direct cooling or heat exchanger type cooling system shall be employed for the diesel engine. Water shall be tapped from the fire pump discharge. This water shall be led through duplex strainer, pressure breakdown orifice and then after passing through the engine, the water at the outlet shall be taken directly to the sump through an elevated funnel.

Testing & Inspection:

The manufacturer shall conduct all tests required, to ensure that the equipment furnished conforms to the requirement of this sub-section and in compliance with requirements of applicable codes. The particulars of the proposed tests and the procedure for the tests shall be submitted to the Employer for approval before conducting the tests.

At manufacturer's works, tests shall be carried out during and after completion of manufacture of different component/parts and the assembly as applicable.

Following tests shall be conducted.

- Material analysis and testing.
- Hydrostatic pressure testing of all pressure parts.
- Static and dynamic balance tests of rotating parts at applicable over- speed and determination of vibration level.
- MPI/DPT on machined parts of piston and cylinder.
- Ultrasonic testing of crankshaft and connecting rod after heat treatment.
- Dimensional check of close tolerance components like piston, cylinder bore etc.
- Calibration tests of all fuel pumps, injectors, standard orifices, nozzles, instruments etc.
- Over speed test of the assembly at 120% of rated speed.
- Power run test.

Performance test of the diesel engine to determine its torque, power and specific fuel consumption as function of shaft speed. Performance test of the engine shall be carried for 12 hours out of which 1 hour at full load and one hour at 110% overload.

Measurement of vibration & noise:

(i) Measurement of vibration

The vibration shall be measured during full load test as well as during the overload test and limit shall be 100 microns.

(ii) Measurement of noise level

The equivalent 'A' weighted sound level measured at a distance of 1.5 M above floor level in elevation and 1.0 M horizontally from the base of the equipment, expressed in dB to a reference of 0.0002 microbar shall not exceed 93 dBA. Above tests for vibration shall be repeated at site as pre-commissioning tests.

Adjustment of speed governor as per BS: 5514.

Diesel engine shall be subjected to routine tests as per IS: 10000/BS: 5514.

7.0 PIPING, VALVES AND SPECIALITIES:

This clause covers the design, manufacture, shop testing, erection, testing and commissioning of piping, valves and specialities.

Scope:

The piping system which shall include but not be limited to the following:

Plain run of piping, bends, elbows, tees, branches, laterals, crosses, reducing unions, couplings, caps, expansion joints, flanges, blank flanges, thrust blocks, anchors, hangers, supports, saddles, shoes, vibration dampeners, sampling connections, hume pipes etc.

Gaskets, ring joints, backing rings, jointing material etc. as required. Also all welding electrodes and welding consumables including special ones, if any.

Instrument tapping connections, stubs etc.

Gate and globe valves to start/stop and regulate flow and swing check valves for one directional flow.

Basket strainers and Y-type strainers:

Bolts, nuts, fasteners as required for interconnecting piping, valves and fittings as well as for terminal points. For pipe connections into Owner's R.C.C. works, Bidder will furnish all inserts.

Painting, anti-corrosive coatings etc. of pipes and equipment. Adequate number of air release valves shall be provided at the highest points in the piping system to vent any trapped air in the system.

Design:

Material of construction of various pipes shall be as follows:

(a) Buried Pipes:

Mild steel black pipes as per IS: 1239, Part-I medium grade (for pipes of sizes 150 NB and below) or IS: 3589, Fe 410 grade (for pipes of sizes 200 NB and above) suitably lagged on the outside to prevent soil corrosion, as specified elsewhere.

(b) Overground Pipes normally full of water:

Mild steel black pipes as per IS: 1239, Part-I medium grade (for pipes for sizes

150 NB and below) or IS: 3589, Fe 410 grade (for pipes of sizes 200 NB and above).

- (c) Overground pipes normally empty, but periodic charge of water and for detector line for HVW System. Mild steel galvanised pipes as per IS: 1239, Part-I medium grade (for pipes of sizes 150 NB and below) or IS: 3589, Fe 410 grade (for pipes of sizes 200 NB and above).

All fittings to be used in connection with steel pipe lines up to a size of 80 mm shall be as per IS:1239. Part-II Mild steel tubulars and other wrought steel pipe fittings, Heavy grade. Fittings with sizes above 80 mm up to 150 mm shall be fabricated from IS:1239 Heavy grade pipes or steel plates having thickness not less than those of IS:1239 Part-I Heavy grade pipes. Fittings with sizes above 150 mm shall be fabricated from IS: 3589 Class-2 pipes. All fitting used in GI piping shall be threaded type. Welding shall not be permitted on GI piping.

Pipe sizes shall not be less than the sizes indicated in the attached drawings.

For steel pipeline, welded construction should be adopted unless specified otherwise.

All piping system shall be capable of withstanding the maximum pressure arising from any condition of operation and testing including water hammer effects.

Gate/slucice valve shall be used for isolation of flow in pipe lines and shall be as per 778 (for size upto 40 mm) and IS: 14846 (for sizes above 40 mm). Valves shall be of rising spindle type and of PN 1.6 class

Gate Valves shall be provided with the following:

- (a) Hand wheel.
- (b) Position indicator.
- (c) Locking facility (where necessary).

Gate valves shall be provided with back seating bush to facilitate gland removal during full open condition.

Globe valves shall be provided with contoured plug to facilitate regulation and control of flow. All other requirements should generally follow those of gate

valve.

Non-return valves shall be swing check type. Valves will have a permanent "arrow" inscription on its body to indicate direction of flow of the fluid. These valves shall generally conform to IS: 5312.

Whenever any valve is found to be so located that it cannot be approached manually from the nearest floor/gallery/platform hand wheel with floor stand or chain operator shall be provided for the same.

Valves below 50 mm size shall have screwed ends while those of 50 mm and higher sizes shall have flanged connections.

BASKET STRAINER:

- a) Basket Strainers shall be of 30meshes and have the following materials of construction: -
 Body: Fabricated Mild Steel as per IS: 2062 (Tested Quality)
 Strainer Wires: Stainless Steel (AISI: 316), 30 SWG suitably reinforced
- b) Inside of Basket Body shall be protected by two (2) coats of heavy – duty bitumastic paint.
- c) Strainers shall be Simplex design. Suitable Vent and Drain connections with Valves shall be provided.
- d) Screen Open Area shall be at least 4 times Pipe Cross Sectional Area at inlet.
- e) Pressure Drop across Strainer in clean condition shall not exceed 1.5 MWC at 410 m3 / hr flow. Pressure Drop Test Report of Strainer of same design shall be furnished.

Y - TYPE ON - LINE STRAINER:

Body shall be constructed of Mild Steel as per IS: 2062 (Tested Quality). Strainer Wires shall be of Stainless Steel AISI: 316, 30 SWG, 30 mesh.

Blowing arrangement shall be provided with removable Plug at the outlet. Screen Open Area shall be at least 4 times Pipe Cross - Sectional Area at inlet.

Pressure Drop Test Report of Strainer of same design shall be furnished.

HYDRANT VALVE (OUTDOOR) AND INDOOR HYDRANT VALVES (INTERNAL LANDING VALVES)

The general arrangement of Outdoor Stand Post Assembly, consisting of a Column Pipe and a Hydrant Valve with a Quick Coupling End shall be as per TAC requirement.

Materials of Construction shall be as follows:

a)	Column Pipe	M.S. IS: 1239 Medium Grade
b)	Hydrant Valve	
	i)	Body Stainless Steel / gun metal
	ii)	Trim Leaded Tin Bronze as per IS:318 Grade-LTB 2

	iii)	Hand Wheel	Cast Iron as per IS:210, Grade FG:200
	iv)	Washer, Gasket, etc.,	Rubber as per IS:638
	v)	Quick Coupling Connection	Leaded Tin Bronze as per IS:318, Grade- LTB 2
	vi)	Spring	Phosphor Bronze as per IS:7608
	vii)	Cap and Chain	Leaded Tin Bronze as per IS:318, Grade-LTB etc.2

The general design of Hydrant Valve shall conform to IS: 5290.

HOSES, NOZZLES, BRANCH PIPES AND HOSE BOXES:

- a) Hosepipes shall be of Reinforced Rubber - Lined Canvas construction as per type A of IS: 636 with nominal size of 63 mm (2½”) and lengths of 15 metres. All Hoses shall be ISI marked.
- b) Hosepipes shall be capable of withstanding an internal water pressure of not less than 35.7 kg/cm² without bursting. It must also withstand a working pressure of 8.5 kg/cm² without undue leakage or sweating.
- c) Each Hose shall be fitted with instantaneous Spring Lock type Couplings at both ends. Hose shall be fixed to the coupling ends by copper rivets and the joint shall be reinforced by 1.5 mm galvanised mild steel wires and leather bands.
- d) Branch Pipes shall be constructed of copper and have rings of leaded tin bronze (as per IS: 318 Grade -2) at both ends. One end of the Branch Pipe will receive the quick coupling while the Nozzles will be fixed to the other end.
- e) Nozzles shall be constructed of leaded tin bronze as per IS: 318, Grade-2.
- f) Suitable Spanners of approved design shall be provided in adequate numbers for easy assembly and dismantling of various Components like Branch Pipes, Nozzles, and Quick Coupling Ends etc.
- g) Hose Pipes fitted with quick coupling ends, branch pipes, nozzle spanner etc., will be kept in a Hose Box, which will be located near point of use. The furnished design must meet the approval of Tariff Advisory Committee.
- h) All Instantaneous Couplings shall be of identical design (both male and female) so that anyone can be interchanged with another. One Male, Female Combination shall get locked in by mere pushing of the two halves together but will provide leak tightness at a pressure of 8 kg/cm² of water. Designs employing screwing or turning to have engagement shall not be accepted.

FABRICATION AND ERECTION:

The Bidder shall fabricate all the pipe work strictly in accordance with the related approved drawings.

End Preparation:

- a) For Steel Pipes, end preparation for butt - welding shall be done by machining.
- b) Socket Weld End Preparation shall be sawing/machining.
- c) For Tees, Laterals, Mitre Bends, and other Irregular details Cutting Templates shall be used for accurate cut.

Pipe Joints:

- a) In general, Pipes having sizes over 25 mm shall be joined by Butt - Welding. Pipes having 25 mm size or less shall be joined by Socket Welding/Screwed Connections. Galvanised Pipes of all sizes shall have screwed joints. No welding shall be permitted on GI Pipes. Screwed Joints shall have tapered threads and shall be assured of leak tightness without using any sealing compound.
- b) Flanged Joints shall be used for connections to Vessels, Equipment, and Flanged Valves and on suitable straight lengths of pipeline of strategic points to facilitate erection and subsequent maintenance work.

Over Ground Piping:

- a) Piping to be laid over ground shall be supported on Pipe Rack / Supports. Rack / Supports details shall have to be approved by Owner.
- b) Surface of Over Ground Pipes shall be thoroughly cleaned of mill scale, rust etc., by wire brushing. Thereafter one (1) coat of red oxide primer shall be applied. Finally, two (2) coats of synthetic enamel paint of approved colour shall be applied.

Buried Pipe Lines:

- a) Pipes to be buried underground shall be provided with protection against soil corrosion by coating and wrapping with two coats of coal tar hot enamel paint and two wraps of reinforced fibreglass tissue. The total thickness of coating and wrapping shall not be less than 3.0 mm. Alternatively, corrosion resistant tapes can also be used for protection of pipes against corrosion.
- b) Coating and Wrapping and Holiday Testing shall be in line with IS: 10221.
- c) Buried Pipelines shall be laid with the top of pipe one metre below ground level.
- d) At Site, during Erection, all coated and wrapped pipes shall be tested with an approved Holiday Detector Equipment with a positive signalling device to indicate any fault hole breaks or conductive particle in coating.

GENERALINSTRUCTION FOR PIPING DESIGN AND CONSTRUCTION:

While erecting Field Run Pipes, the Successful Bidder shall check the accessibility of Valves, Instrument Tapping Points, and maintain minimum headroom requirement and other necessary clearance from the adjoining work areas.

Modification of prefabricated Pipes, if any, shall have to be carried out by the Bidder at no extra charge to the Owner.

Welding:

- i. Welding shall be done by qualified welders only.
- ii. Before welding, the ends shall be cleaned by wire brushing, filing or machine grinding. Each weld-run shall be cleaned of slag before the next run is deposited.
- iii. Welding at any Joint shall be completed uninterrupted. If this cannot be followed for some reason, the weld shall be insulated for slow and uniform cooling.
- iv. Welding shall be done by manual oxyacetylene or manual shielded metal arc process. Automatic or Semi - Automatic Welding Processes may be done only with the specific approval of Owner/Consultant.
- v. As far as possible welding shall be carried out in flat position. If not possible, welding shall be done in a position as close to flat position as possible.
- vi. No backing ring shall be used for circumferential Butt Welds.
- vii. Welding carried out in ambient temperature of 5°C or below shall be heat-treated.

- viii. Tack welding for the alignment of Pipe Joints shall be done only by qualified welders. Since tack welds form part of final welding, they shall be executed carefully and shall be free from defects. Defective welds shall be removed prior to the welding of joints.
Electrodes size for Tack Welding shall be selected depending upon the Root Opening.
- ix. Tacks should be equally spaced as follows:

For 65 NB and smaller Pipes:	2 tacks
For 80 NB to 300 NB Pipes:	4 tacks
For 350 NB and larger Pipes:	6 tacks
- x. Root Run shall be made with respective electrodes/filler wires. The size of the electrodes shall not be greater than 3.25 mm (10 SWG) and should preferably be 2.3 mm (12 SWG). Welding shall be done with Direct Current values recommended by the Electrode Manufacturers.
- xi. Upward Technique shall be adopted for welding pipes in horizontally fixed position. For Pipes with wall thickness less than 3 mm, oxyacetylene welding is recommended.
- xii. The Root Run of butt joints shall be such as to achieve full penetration with the complete fusion of root edges. The weld projection shall not exceed 3 mm inside the Pipe.
- xiii. On completion of each run craters, weld irregularities, slag etc., shall be removed by grinding or chipping.
- xiv. Fillet Welds shall be made by Shielded Metal Arc Process regardless of thickness and class of piping. Electrode size shall not exceed 10 SWG. (3.25 mm). At least two runs shall be made on Socket Weld Joints.

TESTS AT WORKS:

Pipes:

- i. Mechanical and Chemical Tests shall be performed as required in the Codes / Standards.
- ii. All Pipes shall be subjected to Hydrostatic Tests as required in the Codes / Standards.
- iii. 10% Spot Radiography Test on welds of Buried Pipes shall be carried out as per ASME VIII

Valves:

- i. Mechanical and Chemical Tests shall be conducted on materials of the Valve as required in the Codes / Standards.
- ii. All Valves shall be tested hydrostatically for the seat as well as required in the Code / Standards for a period of ten minutes.
- iii. Air Test shall be conducted to Detect Seat Leakage.
- iv. Visual Check on the Valve and Simple Operational Test in which the Valve will be operated thrice from full open to full close condition.
- v. No repair work on CI Valve Body, Bonnet, or Wedge shall be allowed.

Strainers:

- i. Mechanical and Chemical Tests shall be conducted on materials of the Strainer.
- ii. Strainers shall be subjected to a Hydrostatic Test Pressure of 1.5 times the design pressure or 10 kgf / cm²g whichever is higher for a period of one hour.

Hydrant Valves and Indoor Hydrant Valves (Internal Landing Valves):

- i. The Stand Post Assembly along with the Hydrant Valve (Valve being open and outlet closed) shall be pressure tested at a Hydrostatic Pressure of 21 kgf / cm²g to detect any leakage through defects of Casting.
- ii. Flow Test shall be conducted on the Hydrant Valves at a pressure of 7kgf / cm²g and the flow through the Valve shall not be less than 900 litres /min.
- iii. Leak Tightness Test of the Valve Seat shall be conducted at a Hydrostatic Test Pressure of 14kgf / cm²g.

Hoses, Nozzles, Branch Pipes, and Hosen Boxes:

Reinforced Rubber - Lined Canvas Hoses shall be tested hydrostatically.

Following Tests shall be included as per IS: 636.

- a. Hydrostatic Proof Pressure Test at 21.4 kgf/cm²g
- b. Internal Diameter

The Branch Pipe, Coupling, and Nozzles shall be subjected to a Hydrostatically Test Pressure of 21 kg/cm²g for a period of 2½minutes and shall not show any sign of leakage or sweating.

Dimensional Checks shall be made on the Hose Boxes and Nozzle Spanners.

8.0. AIR VESSELS:

Air Vessels shall be designed and fabricated of Mild Steel as Class -II Vessels as per IS: 2825 for a pressure of 14kg/cm²g and shall be minimum 3 m³ capacity.

Inside Surface of the Tank shall be protected by anti-corrosive paints/coatings/linings as required.

Outside Surfaces of the Vessels shall be provided with one (1) coat of red lead primer with two (2) coats of synthetic enamel paint of approved colour and characteristics.

TESTS AND INSPECTION:

Air Vessels shall be hydraulically tested at 21kg/cm²for a period not less than one (1) hour.

All Materials used for fabrication shall be of tested quality and Test Certificates shall be made available to the Owner.

Welding procedure and Welder' qualification tests will be carried out as per relevant IS Standard.

NDE Tests will include 100% Radiography on longitudinal seams and spot Radiography for circumferential seams, for pressure vessel will be carried out.

9.0 HEAT DETECTORS/FIRE DETECTORS AND SPRAY NOZZLES:

INTENT OF SPECIFICATION:

The Specification lays down the requirement of the Smoke Detectors, Heat Detectors, and Spray Nozzles for use in various Sub Systems of the Fire Protection.

CODES AND STANDARDS:

All Equipment supplied shall conform to internationally accepted Codes and Standards. All Equipment offered by Bidders should be TAC approved or have been in use installations, which have been approved by TAC.

HEAT DETECTORS, QUARTZOID BULB TYPE (USE IN HVW SPRAY SYSTEM):

- a. Heat Detectors shall be of any approved and tested type. Fusible Chemical Pellet Type Heat Detectors are however not acceptable.
- b. Temperature rating of the Heat Detector shall be selected by the Bidder taking into consideration the environment in which the Detectors shall operate.
- c. Heat Detectors shall be guaranteed to function properly without any maintenance work for a period of not less than twenty five (25) years.
- d. The Heat Detectors shall be mounted on a Pipe Network charged with water at suitable pressure. On receipt of heat from Fire, the Heat Detector will release the water pressure from the Network. This drop in water pressure will actuate the Deluge Valve.

HVW SPRAY NOZZLES (PROJECTORS):

High Velocity Water Spray System shall be designed and installed to discharge water in the form of a conical spray consisting of droplets of water travelling at high velocity, which shall strike the burning surface which sufficient impact to ensure the formation of an emulsion. At

the same time, the spray shall efficiently cut - off oxygen supply and provide sufficient cooling. Integral non-ferrous Strainers shall be provided in the Projectors ahead of the orifice to arrest higher size particle, which are not allowed to pass through the Projectors.

FIRE DETECTORS (USED IN FIRE DETECTION AND ALARM SYSTEM):

Fire Detectors shall be approved by FOC-London or similar international authorities.

Both Smoke and Heat Type Fire Detectors shall be used. Bidder shall clearly indicate the mode of operation of Detectors in his proposal.

The Set Point shall be selected after giving due consideration for ventilating air velocity and cable insulation.

Fire Detectors shall be equipped with an integral L.E.D so that it shall be possible to know which of the Detectors has been operated. The Detectors, which are to be placed in the space above the false ceiling or in the floor void, shall not have the Response Indicators on the body but shall be provided with Remote Response Indicators.

Fire Detectors shall be guaranteed to function properly without any maintenance work for a period of not less than ten (10) years.

Approval from Department of Atomic Energy (DAE), Government of India shall be made available for Ionisation Type Smoke Detectors. All Accessories required to satisfy DAE shall also be included in the Scope of Supply of the Contractor.

PORTABLE AND WHEEL/ TROLLEY MOUNTED FIRE EXTINGUISHERS:

This specification lays down the requirement regarding fire extinguishers of following types:

Portable fire extinguishers.

- a) Pressurised water type.
- b) Dry chemical powder type
- c) Carbon Dioxide type

Wheel/ Trolley mounted fire extinguishers.

- a) Mechanical foam type

All the extinguishers offered by the Bidder shall be of reputed make and shall be ISI marked.

Design and Construction

All the portable extinguishers shall be of freestanding type and shall be capable of discharging freely and completely in upright position.

Each extinguisher shall have the instructions for operating the extinguishers on its body itself.

All extinguishers shall be supplied with initial charge and accessories as required.

Portable type extinguishers shall be provided with suitable clamps for mounting on walls or columns.

All extinguishers shall be painted with durable enamel paint of fire red colour conforming to relevant Indian Standards.

Pressurisation of water type fire extinguishers shall either be done by compressed air or by using gas cartridge. The constant air pressure type shall conform to IS: 6234 and the gas pressure type shall conform to IS: 940. Both these extinguishers shall be ISI marked.

Dry chemical powder type portable extinguisher shall conform to IS: 2171.

Carbon Dioxide type portable extinguisher shall conform to IS: 2878.

Wheel/ trolley mounted fire extinguishers of 50 litre capacity Mechanical foam type shall conform to IS: 13386

Tests and Inspection:

A performance demonstration test at site of five (5) percent or one (1) number whichever is higher, of the extinguishers shall be carried out by the Contractor. All consumable and replaceable items require for this test would be supplied by the Contractor without any extra cost to Employer.

Performance testing of extinguisher shall be in line of applicable Indian Standards. In case where no Indian Standard is applicable for a particular type of extinguisher, the method of testing shall be mutually discussed and agreed to before placement of order for the extinguishers.

Painting:

Each fire extinguisher shall be painted with durable enamel paint of fire red colour conforming to relevant Indian Standards.

10.0 INSTRUMENTS:

INTENT OF SPECIFICATION:

The requirements given in the Section shall be applicable to all the Instruments being furnished under this Specification.

All Field Mounted Instrument shall be weather and dust tight, suitable for use under ambient conditions prevalent in the Subject Plant. All Field Mounted Instruments shall be mounted in suitable locations where maximum accessibility for maintenance can be achieved.

LOCAL INSTRUMENTS:

Pressure/Differential Gauges and Switches:

The Pressure Sensing Elements shall be continuous 'C' Bourdon type.

The Sensing Elements for all Gauges / Switches shall be properly aged and Factory Tested to remove residual stresses. They shall be able to withstand at least twice the full - scale pressure/vacuum without any damage or permanent deformation.

For all Instruments, connection between the Pressure Sensing Element and Socket shall be braced or hard soldered.

Gauges shall be of 150mm diameter dial with die-cast aluminium, stoved enamel black finish case, aluminium screwed ring and clear plastic crystal cover glass. Upper Range Pointer Limit Stop for all Gauges shall be provided.

All Gauges shall be with Stainless Steel Bourdon having rotary - geared stainless steel movements.

Weatherproof type construction shall be provided for all Gauges. This type of construction shall be fully dust tight, drip tight, weather resistant and splash proof with anti-corrosive painting conforming to NEMA-4.

All Gauges shall have Micrometre Type Zero Adjuster.

Neoprene Safety Diaphragm shall be provided on the back of the Instruments Casing for Pressure Gauges of ranges 0-10 kg/cm² and above.

Scale shall be concentric, White with Black Lettering and shall be in metric units.

Accuracy shall be ± 1.0 percent of full range or better.

Scale Range shall be selected so that normal process pressure is approximately 75 percent of full - scale reading. For Pressure Gauges and Pressure Switches, the Range shall not be less than 0-16 kg /cm²

All Gauges shall have ½ inch NPT bottom connection.

All Instruments shall conform to IS: 3624 -1966.

All Instruments shall be provided with 3 Ways Gauge Isolation Valve or Cock. Union, Nut, Nipple, and Tail Pipe shall be provided wherever required.

Switch Element Contact shall have two (2) NO and two (2) NC Contacts rated for 240 Volts, 10 Amperes A. C. Or 220 Volts, 5 Amperes D. C. Actuation Set Point shall be adjustable throughout the range. ON-OFF differential (difference between Switch Actuation and De - Actuation Pressures) shall be adjustable. Adjustable Range shall be suitable for Switch Application.

Switches shall be sealed diaphragm, position type with snap action switch element. Diaphragm shall be of 316 SS.

Necessary Accessories shall be furnished.

TIMERS:

The Timers shall be electro- mechanical type with adjustable delay on pickup or reset as required.

Each Timer shall have two pairs of contacts in required combination of NO and NC.

LEVEL GAUGES / INDICATOR / SWITCHES:

Level Gauges:

- a) Gauge Glasses shall be used for local level indication wherever shown in the Flow Diagram.
- b) Gauge Glasses, in general, shall be Flag Glass type with Bolted Cover. Body and Cover Material shall be of carbon steel with rubber lining.
- c) Level Coverage shall be in accordance with operating requirement. Maximum length of a Single Gauge Glass shall not exceed 1.4 metres should a larger Gauge Glass be required, multiple gauges of preferable equal length shall be used with 50 mm overlap in visibility.
- d) Reflex Type Gauge Glasses shall be used for colourless liquids and transparent type Gauge Glasses shall be used for all liquid having colour.
- e) Each Gauge Glass shall be complete with a pair of Offset Valves. Valves shall have gauge union bonnet, female union level connection, flanged tank connection, and vent and drain plug.
- f) Offset Valves shall have corrosion resistant ball- check to prevent fluid loss in the event of Gauge Glass Breakage. Valve Body shall have working pressure of 200 % of the maximum static pressure at the maximum process fluid temperature. Valve Body Materials shall be of carbon steel with rubber lining.

Level Indicators:

- i) Float Type Mechanical Level Gauges with Linear Scale Type Indicator shall be offered for measuring level of Tanks.

- ii) AISI-316 Stainless Steel Float, Guide Rope, and Tape shall be used. Housing shall be of mild steel painted with anti-corrosive painting.
- iii) The Scale Indicator shall be provided at a suitable height for ease of reading.
- iv) Accuracy shall be + 1% of Scale Range or better.

Level Switches:

- i) Level Switches shall be of Ball Float Operated Magnetic type complete with cage.
- ii) Material of construction shall be suitable for process and ambient conditions. The Float Material shall be AISI-316 Stainless Steel.
- iii) Actuating Switches shall be either Hermetically Sealed Mercury type or Snap Acting Micro -Switches. Actuation Set Point shall be adjustable. ON-OFF Differential (difference between Switch Actuation and De - Actuation Levels) shall be adjustable. Adjustable Range shall be suitable for Switch Application. All Switches shall be repeatable within +1.0 percent of liquid level change required to activate Switch. Contacts shall be rated for 50 Watts at 240 V A. C. Number of Contacts shall be two NO and two NC for each Level Switch.

SOLENOID VALVES:

The Body of the Valves shall be Forged Brass or Stainless Steel.

The Coil shall be continuous duty, epoxy moulded type Class -F, suitable for high temperature operation.

The Enclosure shall be watertight, dust-tight and shall conform to NEMA-4 Standard.

The Valves shall be suitable for mounting in any position.

SWITCH, LAMPS, METERS etc:

All Electrical Components on the Panel namely Push Buttons, Switches, Lamps, Meters etc., shall meet the requirements.

All Local Instruments shall be inspected by Owner/ Consultant as per the agreed Quality Plan.

Makes of Control Panel and Local Instruments, Accessories shall be as per Owner's approval.

11.0 ELECTRIC MOTORS:

General:

This clause covers the requirements of three phase squirrel cage induction motors and single-phase induction motors.

The motors to be furnished, erected and commissioned as covered under this specification shall be engineered, designed, manufactured, erected, tested as per the requirements specified herein. These requirements shall however be read along with the requirements of the respective driven equipment being supplied under the specification of which this specification forms a part.

The motor supplied under this specification shall conform to the standards specified in GTR.

Terminal point for all motors supplied under this specification shall be at the respective terminal boxes.

Materials and components not specifically stated in this specification but are necessary for satisfactory operation of the motor shall be deemed to be included in the scope of supply of this specification.

Notwithstanding anything stated in this motor specification, the motor has to satisfy the requirement of the mechanical system during normal and abnormal conditions. For this the motor manufacturer has to co- ordinate with the mechanical equipment supplier and shall ensure that the motor being offered meets the requirements.

Codes & Standards:

The design, manufacture, installation and performance of motors shall conform to the provisions of latest Indian Electricity Act and Indian Electricity Rules. Nothing in these specifications shall be construed to relieve the Contractor of his responsibility.

In case of contradiction between this specifications and IS or IEC, the stipulations of this specification shall be treated as applicable.

National Electrical code for hazardous location and relevant NEMA standard shall also be applicable for motors located in hazardous location.

Design Features:

Rating and type:

- (i) The induction motors shall be of squirrel cage type unless specified otherwise.
- (ii) The motors shall be suitable for continuous duty in the specified ambient temperature.
- (iii) The MCR KW rating of the motors for 50oC ambient shall not be less than the power requirement imposed at the motor shaft by the driven equipment under the most onerous operation conditions as defined elsewhere, when the supply frequency is 51.5 Hz (and the motor is running at 103% of its rated speed).
- (iv) Motors shall be capable of giving rated output without reduction in the expected life span when operated continuously in the system having the following particulars :
 - (v) Rated terminal voltage
 - (vi) From 0.2 to 200, KW 415V (3 Phase, solidly earthed) Below 0.2KW ,240 V (1 Phase, solidly earthed) Variation in voltage + 6%.
 - (vii) Frequency 50 Hz + 3%.
 - (viii) Any combination of (a) & (b)

Enclosure:

Motors to be installed outdoor and semi-outdoor shall have hose proof enclosure equivalent to IP-55 as per IS: 4691. For motors to be installed indoor, the enclosure shall be dust proof equivalent to IP-54 as per IS: 4691.

Cooling method:

Motors shall be TEFC (totally enclosed fan cooled) type.

Starting requirements:

(i) **Induction motor:**

- a) All induction motors shall be suitable for full voltage direct on-line starting. These shall be capable of starting and accelerating to the rated speed along with the driven equipment without exceeding the acceptable winding temperature even when the supply voltage drops down to 80% of the rated voltage.
- b) Motors shall be capable of withstanding the electro-dynamic stresses and heating imposed if it is started at a voltage of 110% of the rated value.
- c) The starting current of the motor at rated voltage shall not exceed six (6) times the rated full load current subject to tolerance as given in IS : 325.
- d) Motors when started with the driven equipment imposing full starting torque under the supply voltage condition specified under Clause Rating and type(iv) above (a) shall be capable of withstanding at least two successive starts with coasting to rest between starts and motor initially at the rated load operating temperature. The motors shall also be suitable for three equally spread starts per hour, the motor initially at a temperature not exceeding the rated operating temperature.
- e) The locked rotor withstand time under hot condition at 110% of rated voltage shall be more than the starting time with the driven equipment at minimum permissible voltage) by at least two seconds or 15% of the accelerating time whichever is greater. In case it is not possible to meet the above requirement the Bidder shall offer centrifugal type speed switch mounted on the motor shaft which shall remain closed for speeds lower than 20% and open for speeds above 20% of the rated speed. The speed switch shall be capable of withstanding 120% of the rated speed in either direction of rotation.

Running requirements:

- (i) When the motors are operating at extreme condition of voltage and frequency

given in this specification, the maximum permissible temperature rise over the ambient temperature of 50°C shall be within the limits specified in IS : 325 after adjustment due to increase ambient temperature specified herein.

- (ii) The double amplitude of motor vibration shall be within the limits specified in IS: 4729. Vibration shall also be within the limits specified by the relevant standard for the driven equipment when measured at the motor bearings.
- (iii) All the induction motors shall be capable of running at 80% of rated voltage for a period of 5 minutes with rated load commencing from hot condition.
- (iv) Induction motors shall be so designed as to be capable of withstanding the voltage and torque stresses developed due to the difference between the motor residual voltage and incoming supply voltage during fast changeover of buses. The necessary feature incorporated in the design to comply with this requirement shall be clearly indicated in the proposal.
- (v) Motors shall be capable of developing the rated full load torque even when the supply voltage drops to 70% of rated voltage. Such operation is envisaged for a period of one second. The pull out torque of the induction motors to meet this requirement shall not be less than 205% of full load torque.
- (vi) The motors shall be capable of withstanding for 10 seconds without stalling or abrupt change in speed (under gradual increase of torque) an excess torque of 60 percent of their rated torque, the voltage and frequency being maintained at their rated value.
- (vii) Guaranteed performance of the motors shall be met with tolerances specified in respective standards.

Construction Features:**Stator:****(i) Stator frame:**

The stator frames and all external parts of the motors shall be rigid fabricated steel or of casting. They shall be suitably annealed to eliminate any residual stresses introduced during the process of fabrication and machining.

(ii) Stator core:

The stator laminations shall be made from suitable grade magnetic sheet steel varnished on both sides. They shall be pressed and clamped adequately to reduce the core and teeth vibration to minimum.

(iii) Insulation and winding:

All insulated winding conductor shall be of copper. The overall motor winding insulation for all 415 volts motors shall be of epoxy thermosetting type i.e., class 'F' but limited to class-B operating from temperature rise consideration. Other motors may be of conventional class-B type. The windings shall be suitable for successful operation in hot, humid, tropical climate with the ambient temperature of 50oC.

Rotor:

- (i) Rotors shall be so designed as to keep the combined critical speed with the driven equipment away from the running speed by at least 20%.
- (ii) Rotors shall also be designed to withstand 120% of the rated speed for 2 minutes in either direction of rotation.

Terminal box leads:

- (i) For motors of 415 Volts and below a single terminal box may be provided for power and accessories leads.
- (ii) Terminal boxes shall be of weatherproof construction designed for outdoor service. To eliminate entry of dust and water, gaskets of neoprene or approved equivalent shall be provided at cover joints and between box and motor frame.
- (iii) Terminal box shall be suitable for top and bottom entry of cables.

- (iv) Unless otherwise approved, the terminal box shall be capable of being turned through 360o in steps in 90o.
- (v) The terminals shall be complete with all accessories for connecting external cables. They shall be designed for the current carrying capacity and shall ensure ample phase to phase to ground clearances.
- (vi) Suitable tinned brass compression type cable glands and cable lugs shall be supplied by the Contractor to match Employer's cable.
- (vii) Terminal box for single core cable shall be of non- magnetic material.
- (viii) Marking of all terminals shall be in accordance with IS: 4728.

Rating Plates:

- (i) Rating plates shall be provided for all motors giving the details as called for in IS: 325 (for three phase squirrel cage induction motors).
- (ii) In addition to above, the rating plate shall indicate the following :
 - a) Temperature rise in °C under normal working conditions.
 - b) Phase sequence corresponding to the direction of rotation for the application.
 - c) Bearing identification number (in case of ball/ roller bearing) and recommended lubricants.

Other Constructional Features:

- (i) Two independent earthing points shall be provided on opposite sides of the motor for bolted connection of Employer's earthing conductor to be specified to the successful Bidder.
- (ii) Motor weighing more than 25 kg. Shall be provided with eyebolts, lugs or other means to facilitate lifting.

Paint and Finish:

Motor external parts shall be finished and painted to produce a neat and durable surface, which would prevent rusting and corrosion. The equipment shall be thoroughly degreased, all sharp edges and scales removed and treated with one coat of primer and two coats of grey enamel paint.

Motor fans shall also be painted to withstand corrosion.

All fasteners used in the construction of the equipment shall be either of corrosion resistant material or heavy cadmium plated.

Current carrying fasteners shall be either of stainless steel or high tensile brass.

Tests at Manufacturers Works:

Motors shall be subject to routine tests in accordance with IS: 325 & IS: 4029 standards.

In addition, the following tests shall also be carried out:

- a) 20% over speed test for 2 minutes on all rotors.
- b) Measurement of vibration.
- c) Measurement of noise level.
- d) Phase sequence and polarity checks relative to mechanical rotation.

Tests after installation at site:

- (i) After installation and commissioning at site, the motors along with the driven equipment shall be subject to tests to ascertain their conformity with the requirement of this specification and those of the driven equipment specification and the performance data quoted by the Bidder.
- (ii) In case of non-conformity of the motor with these specifications and performance requirement, the Engineer may at his discretion reject or ask for necessary rectification/replacement as detailed in general Terms and Conditions of Contract.

12.0 BATTERY & BATTERY CHARGERS:

This clause covers the design, performance, manufacturing, construction features and testing of Battery and Battery charger used primarily for starting the diesel engine driving the fire water pumps. Battery Chargers shall be housed in Diesel Engine Panel.

General Information:

The equipment specified hereinafter are required for starting the diesel engines and other operation of the plant as required.

For each diesel engine there shall be two (2) sets of Battery and two (2) sets of Battery Charger.

The D.C. voltage shall be obtained normally after necessary rectification by battery charger. The Battery Charging system shall be capable of meeting the following requirements:

Float charging the Battery.

Boost Charging the Battery.

The battery shall be large enough to crank the engine 3 times without charging in between and without getting drained to an extent which will affect its life.

The Bidder shall indicate the battery voltage and battery capacity in Ampere- Hour at ten (10) hour discharge rate. The battery voltage at any time during operation shall not be less than the minimum voltage required for operation of the D.C. loads.

General Design:

The Battery shall be located indoor

Battery:

- (i) The cells shall be lead-acid type. The Battery shall be automotive type.
- (ii) The cells shall be sealed in type with anti-splash type vent plug.
- (iii) The cell terminal posts shall be provided with connector bolts and nuts, effectively coated with lead to prevent corrosion. Lead or lead coated copper connectors shall be furnished to connect up cells of battery set.
- (iv) Positive and Negative terminal posts shall be clearly and indelibly marked for easy identification.
- (v) The electrolyte shall be of battery grade Sulphuric Acid conforming to IS: 226-2962. Water for storage batteries conforming to IS: 1069 shall be used in the preparation of the electrolyte.

Battery Charger:

(i) The Bidder shall furnish the battery charging scheme complete with all necessary accessories such as transformers, switches, fuses, starters, contactors, diodes, ammeters, voltmeters and other devices as required for trouble free operation. All devices and equipment shall conform to relevant Indian Standard or shall be Superior to it.

(ii) The scheme of the battery charger shall be such that the battery can be charged automatically as well as manually.

(iii) The boost charger shall have sufficient capacity to restore a fully discharged Battery to a state of full charge in eight (8) hours with some spare margin over maximum charging rate. Suitable provision shall be kept so that, for a particular engine, any of the two (2) charger units can be used for charging any of the two (2) batteries.

(iv) The instruments, switches and lamps shall be flush/semi-flush mounted on the front panel. Name plate of approved type shall be provided for each of these equipment.

(v) The panel shall be complete with internal wiring and input-output terminal block. Terminal blocks shall be clip on type of suitable rating. All equipment and wire terminals shall be identified by symbols corresponding to applicable schematic/wiring diagram.

(vi) Space heaters of adequate capacity shall be provided to prevent moisture condensation in the panel.

Testing:

The Battery Charger shall also be subjected to the following tests at manufacturer's works as per IS - 4540

- Insulation test.
- Connection checking.
- Measurement of voltage regulation.
- Auxiliary of devices.
- Alternating current measurement.
- Performance test.
- Temperature rise test.

Following acceptance tests shall be carried out in batteries as per IS:1651.

- a) Marking and packing
- b) Verification of dimensions
- c) Test for capacity
- d) Test for voltage during discharge

Battery and battery charger shall be checked for auto charging and providing sufficient power for three consecutive starting kicks to diesel engine within five minutes with A.C. supply switched off.

13.0 CONTROL AND ANNUNCIATION PANELS:

INTENT OF SPECIFICATION:

The following requirement shall be applicable to the Control and Annunciation Panels furnished under these Specifications: -

GENERAL INFORMATION:

The Equipment specified herein are required for Controlling, Metering, Monitoring and Indication of Electrical Systems of the Plant offered.

The selection and design of all the Equipment shall be to ensure reliable and safe operation of the Plant and shall be subjected to approval by the Owner.

The reference ambient temperature outside the Panel shall be taken as 50°C and relative humidity 100%.

EQUIPMENTS TO BE FURNISHED:

Control and Annunciation Panels shall be furnished complete with all Accessories and Wiring for safe and trouble free operation of the Plant.

CONSTRUCTIONAL DETAILS:

The Panel Frames shall be fabricated using suitable mild steel structural sections or pressed and shaped cold rolled sheet steel of thickness not less than 2.5 mm. Frames shall be enclosed in cold rolled sheet steel of thickness not less than 1.6mm. Stiffeners shall be provided wherever necessary.

Panels shall be of freestanding type and shall be provided with hinged door with locking arrangement. The access doors, cutest and covers shall be equipped with neoprene/synthetic rubber gaskets (conforming to IS: 11149-1984) all around and the latches sufficiently strong to hold them in alignment when closed. The Panels to be installed outdoor or semi outdoor shall have a degree of protection of IP: 55 and those installed Indoor shall have a degree of Protection of IP: 52 as per IS: 13947, Part – 1.

If a Panel consist of a number of Panels, each Panel should be mounted side by side and bolted together to form a Compact Unit, when two Panels meet, the joints shall be smooth, close fittings and un-obstructive.

Removable Eye Bolt or Lifting Lugs shall be provided on all Panels to facilitate easy lifting.

The heights of all operating Equipment on the Panel shall be between 800mm to 1600mm from the finished floor level. The proper supporting arrangement shall be provided by the Bidder.

Cable Entries to the Panel may be from bottom or top. A suitable removable gland plate of 3mm thick shall be mounted not less than 200 mm above the floor level.

All Equipment mounted on the front face of the Panels shall be flush or semi- flush type. All Equipment shall be so located that their terminal and adjustment are readily accessible for inspection or maintenance and their removal and replacement can be done without interruption of service to other Equipment. The Bidder shall submit the Panel General Arrangement Drawing clearly bringing out Internal Mounting Details, Dimensions of Equipment, Clearance between the Equipment and the edges of the Panel, for approval.

NAME PLATES AND LABELS:

Each Panel shall be provided with prominent, engraved identification plates for all front mounted Equipment. Panel Identification Nameplate shall be provided at front and rear as required.

All Nameplates shall be of non-rusting metal or 3 – ply lamicold, with white engraved lettering on black background. Inscription and lettering sizes shall be subjected to Owner's approval.

Suitable Plastic Sticker Labels shall be provided for easy identification of all Equipment located inside the Panel. These Labels shall be positioned to be clearly visible and shall give the Device Number.

AC/DC Power Supply:

The Employer will provide one feeder each for AC and DC to the panel. The Contractor shall make for his own arrangements for providing these power supplies to different panels.

The Contractor shall provide suitable isolating switch fuse unit in the control panel for receiving the above incoming AC and DC supplies. Fuse and link

shall be provided for isolating of individual circuit without disturbing other circuits.

WIRING:

All Inter Panel Wiring and Connections between Panels (if there is Group of Panels) including all Bus Wiring for A.C. and D.C. Supplies shall be provided by the Bidder.

All Internal Wiring shall be carried out with 1,100 V grade, single core, 1.5 square mm or larger stranded copper wires having colour-coded PVC Insulation. CT Circuits shall be wired with 2.5 square mm copper wires, otherwise similar to the above.

Extra- Flexible Wire shall be used for wiring to Devices mounted on moving parts such as Doors.

Spare Contacts of Auxiliary Relays, Timers, and Switches shall be wired out to the Terminal Blocks as required by the Owner/Engineer at the time off detailed engineering.

TERMINAL BLOCKS:

Terminal Blocks shall be of 650V grade, rated for 10 Amperes and in one - piece moulding. It shall be complete with Insulating Barriers, Clip – On - Type Terminals, and Identification Strips. Marking on Terminal Strip shall correspond to the terminal numbering on wiring diagrams.

Terminal Blocks shall be arranged with at least 100 mm clearances between two sets of Terminal Block.

The Terminal Blocks shall have at least 20% Spare Terminals.

GROUNDING:

A continuous copper 25 x 3 mm size shall be provided along the bottom of the Panel Structure. It shall run continuously throughout the length of the Panel and shall have provision at both ends for connection to the Station Grounding Grid (25 x 6 mm MS Flat).

SPACE HEATER AND LIGHTING:

Space Heaters shall be provided in the Panels for preventing harmful moisture condensation.

The Space Heaters shall be suitable for continuous operation on 240 V AC, 50Hz, single - phase supply and shall be automatically controlled by thermostat. Necessary Isolating Switches and Fuses shall also be provided.

Free standing Panel shall have a 240 V AC, Plug Point, and a Fluorescent Light operated by Door Switch.

CONTROL AND SELECTOR SWITCHES:

Control and Selector Switches shall be of rotary type, with escutcheon plates clearly marked to show the function and positions.

Control/ Selector Switches shall be spring return or stay put type as per the requirements. Handles of Control / Selector Switches shall be black in colour. Shape and type of Handles shall be approved by the Owner.

The Contact Ratings shall be at least the following:

- i) Make and Carry continuously 10 Amperes
- ii) Breaking Current at 240V D. C.1 Ampere (Inductive)
- iii) Breaking Current at 240 V D. C.5 Amperes at 0.3 p.f. lagging

PUSH BUTTONS:

Push Buttons shall be spring return, push to actuate type and rated to continuously carry and break 10 Amperes at 240V A. C. and 0.5 Ampere (Inductive) at 220V D. C. The Push Buttons shall have at least 1 NO and 1 NC Contact. All Contact Faces shall be of silver or silver alloy.

All Push Buttons shall be provided with integral escutcheon plates marked with its function.

The Colour of Buttons shall be as follows:

GREEN for Motor 'Start', Breaker 'Close', Valve/ Damper 'Open'

RED for Motor 'Trip', Breaker 'Open', Valve/ Damper 'Close'

BLACK for all Annunciation Functions, Overload Reset, and Miscellaneous.

Red Push Buttons shall always be located to the left of Green Push Buttons.

INDICATING LAMPS:

Indicating Lamps shall be of the Panel mounting, filament type and of low-watt consumption. Lamps shall be provided with series resistors preferably built in the Lamps Assembly. The Lamps shall have escutcheon plates marked with its function, wherever necessary.

Lamp shall have Translucent Lamp Covers of the following Colours:

RED for Motor 'Off', Valve/ Damper 'Open', Breaker 'Closed'

GREEN for Motor 'On', Valve/ Damper 'Closed', Breaker 'Open'

WHITE for Motor 'Auto - Trip'.

BLUE for all Healthy Conditions (e.g. Control Supply, Lub Oil Pressure and for Spring Charged).

AMBER for Alarm Conditions (e.g. Pressure Low, Over Load and for 'Service' and 'Test' Position Indication).

Bulbs and Lamps Covers shall be easily replaceable form the front of the Panel.

Indicating Lamps should be located directly above the associated Push Button / Control Switches. Red Lamps shall invariably be located to the Right of the Green Lamp. In case a

White Lamp is also provided, it shall be placed between the Red and Green Lamps. Blue and Amber Lamps should normally be located above the Red and Green Lamps.

FUSES:

All Fuses shall be of HRC Cartridge 'Plug – in' type and shall be of suitable rating, depending upon Circuit requirements.

All Fuses shall be mounted on Fuse Carriers, which shall be mounted on Fuse - Bases.

CONTACTORS:

Contactors shall be of Air Break, Electromagnetic type rated as per requirement. These shall be of utilisation category AC 3 as per IS: 2959.

Operating Coils of A.C. Contactors shall be of 240 V A.C. or 220V D.C. as required. A.C. Contactors shall operate satisfactorily between 85% to 110% of the Rated Voltage. The Contactor shall not drop out at 70% of the Rated Voltage.

D.C. Contactors shall have a Coil Voltage of 220V D. C. and shall be suitable for satisfactory continuous operation at 80% to 110% of the Rated Voltage.

RELAYS AND TIMERS:

All Auxiliary Relays and Timers shall be of proven design and of reputed make. Contacts of Relays and Timers shall be of solid silver or silver cadmium oxide or solid silver faced. Timers shall have the provision to adjust the delay on pick-up or reset as required.

All Relays and Timers shall have at least two NO and two NC Contacts.

All Relays and Timers shall be suitable for 240V A.C. and 220V D.C. as required. D.C. Relays shall operate satisfactorily between 70% to 110% and A.C. Relays shall be suitable for Voltage variation between 80% to 110%.

INDICATION INSTRUMENTS:

All Indicating and Integrating Meters shall be flush mounted on Panel front. The Instruments shall be of at least 96mm square size with 90 - degree scales and shall have an Accuracy Class of 1.0 or better. The Covers, Cases of Instruments, and Meters shall provide a dust and vermin proof construction.

All Instruments shall be compensated for temperature errors and factory calibrated to directly read the primary quantities. Means shall be provided for 'Zero' adjustment without removing or dismantling the Instruments.

All Instruments shall have White Dials with Black Numerals and Lettering. Black knife – edge Pointer with parallax free dials will be preferred.

Ammeters provided on Motor Feeders shall have a compressed scale at the upper Current region to cover the starting Current.

ANNUNCIATION SYSTEM:

The Annunciation System shall be complete with all necessary Relays, Flashers and other Accessories required for the proper operation of the Equipment and shall be completely solid state. The Control Circuit shall be mounted on plug-in type glass epoxy printed circuit boards. Audible Alarms for the System shall be mounted inside the Panel. One set of Acknowledge, Test, and Reset Push Buttons shall be mounted on the Panel.

Indications shall be engraved on Acrylic Inscription Plate Window and shall be visible clearly, when the Indication Lamp is lighted (Black Letters on White Background). Each Window shall be provided with two Lamps.

Audible Hooter shall sound when a trouble contact operates and shall continue to sound until the Acknowledge Button is pressed. In addition to the Hooters provided on Annunciation Panels, a Hooter shall be provided outside FFPH that shall sound in any Fire Alarm Condition.

Indication Lamps shall flash when trouble contact operates and shall continue flashing until Acknowledge Button is pressed.

After Acknowledge Button is pressed, the Hooter and Flashing shall stop but the Indication Lamp shall remain lighted.

After trouble is cleared, Indication Lamps shall be ready and shall go 'Off' only when reset.

Silencing the Hooter in conjunction with one trouble contact shall not stop and Hooter sounding if another trouble contact operates.

When Test Button is pressed, all Lamps shall flash and Hooter shall sound.

Annunciator System shall operate on 220V D. C. Systems.

The Annunciation System shall include Alarm for A. C. Control System Failure (working on D. C. Supply), D. C. Supply Failure (working on A. C. Supply), and Test Facilities for these Alarms.

The Bidder shall also provide additional Annunciations if desired by the Owner/Engineer during Vendor Drawing Review Stage and for such additional Annunciations no extra charges shall be claimed by the Bidder, if the number of such additions are within 10% of the number stipulated in this Specification.

20% Spare Windows shall be provided on the Panel.

PAINTING:

All Sheet Steel Work shall be pre - treated in tanks, in accordance with IS: 6005. Degreasing shall be done by alkaline cleaning. Dust and Scale shall be removed by pickling. The Parts shall be washed in running water. Then these shall be rinsed in slightly alkaline hot water and dried. The phosphate coating shall be "Class - C" as specified in IS: 6005. The phosphate surfaces shall be rinsed and passivated prior to application of stoved lead oxide primer coating. After primer application, two coats of finishing synthetic enamel paint on Panels shall be applied. Electrostatic Painting shall also be acceptable. Finishing Paint on Panels shall be Shade 692 (Smoke Grey) of IS: 5 unless required otherwise by the Owner. The inside of the

Panels shall be Glossy White. Each coat of finishing shall be properly stoved. The paint thickness shall not be less than 50 microns. Finished parts shall be coated by peelable compound by Spraying Method to protect the finished surface from scratches, grease, dirt, and oil spots during testing, transportation, handling and erection.

Tests:

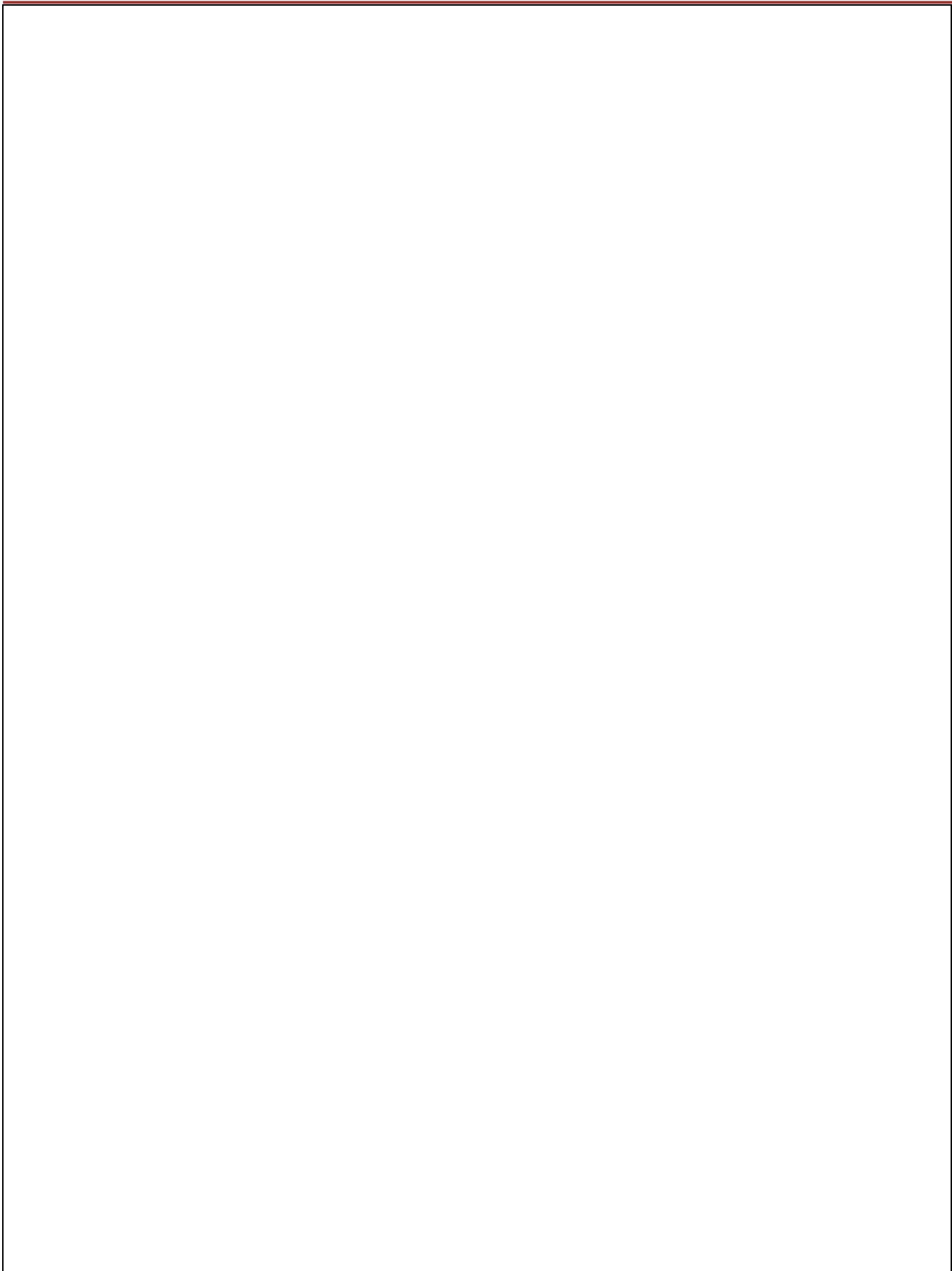
Following tests/inspection shall be carried out by the Contractor in the presence of Employer's representative:

(A) Factory Tests:

1. Compliance with approved drawings, data and specification.
2. Visual check for workmanship.
3. Wiring continuity and functional checks.
4. Calibration of instruments, relays and metres wherever required by inspector.
5. HV test
6. Insulation resistance measurement before and after HV test.

(B) Inspection/Testing at site:

1. IR test before and after HV test
 2. HV Test
 3. Functional Testing.
-
1. The Fire detection and annunciation panel shall be subjected to functional tests.
 2. The Annunciation System shall be routine tested



APPENDIX – 1
TECHNICAL DATASHEETS
FOR DELUGE VALVE

1.0	Manufacturer	OPTCL approved vendor
2.0	Number and Size	To be finalised during detailed engineering
3.0	Type	Differential Diaphragm Type
4.0	Rating	
4.1	Flow in m ³ /hr	
	150 mm ϕ	170 to 650
	100 mm ϕ	50 to 225
4.2	Pressure	
	Working Pressure	12.3kg / cm ²
	Test Pressure	25kg / cm ²
4.3	Pressure Drop in equivalent Length	
	150 mm ϕ	19 metres
	100 mm ϕ	11 metres
5.0	Material of Construction	
5.1	Body	CI IS: 210Gr. FG260
5.2	Valve internal	Cast Bronze–IS:318-LTB2
5.3	Seat Seal	Neoprene Rubber
5.4	Diaphragm	Neoprene Rubber
6.0	Differential Pressure required for Operation	Differential Ratio–50%
7.0	Water Motor Gong provided	Yes
7.1	Type	Hydraulic
7.2	Material of Construction	
7.2.1	Housing	Al. Alloy-IS:617
7.2.2	Cover/Rotor/Gong	Aluminium to IS:737
7.2.3	Manual Actuation Lever provided.	Yes
8.0	Remote Actuation with Solenoid Valve provided.	Yes
9.0	Resetting Type	Manual Resetting
10.0	Deluge Valve complete with TEST and Drain Valves, Manual	Yes

	Operation Arrangement, Supporting Structures, and all necessary Accessories	
11.0	Approval of Deluge Valve	FM of USA, UL of USA, LPCB of U.K. or VDS of Germany

APPENDIX – 2
TECHNICAL DATASHEET
FOR HVW SPRAYNOZZLE

1.0	Make	OPTCL approved vendor
2.0	Type	High Velocity Water Spray Type
3.0	Working Pressure	3.5bar to 5.0bar
4.0	Material	Brass
5.0	K – Factor	As per Approved Design and Drawings
6.0	Quantity	As per approved Design and Drawings
7.0	Integral Non – Ferrous Strainer provide	Yes
8.0	Approval of HVW Spray Nozzle	FM of USA, UL of USA, LPCB of U.K. or VDS of Germany

APPENDIX – 3

**TECHNICAL DATASHEET
FOR QUARTZOID BULB DETECTORS**

1.0	Make	OPTCL approved vendor
2.0	Type	Quartzoid Bulb
3.0	Rated Pressure	12.3kg/cm ² (175PSI)
4.0	Hydro Test Pressure	30kg /cm ²
5.0	Material of Construction	
5.1	Frame	Bronze
5.2	Bulb	Glass
5.3	Deflector	Copper
6.0	Temperature Rating	79°C
7.0	Quantity	As per Approved Drawings
8.0	Approval of Detector	FM of USA, UL of USA, LPCB of U.K. or VDS of Germany

APPENDIX – 4

**TECHNICAL DATASHEET
FOR OPTICAL SMOKE DETECTOR**

1.0	Manufacturer	OPTCL approved vendor
2.0	Principle of Operation	Light Scattering by Smoke Particles
3.0	Maximum Recommended Spacing	9metres
4.0	Normal Operating Temperature	-10 °C to 60 °C
5.0	Guaranteed to function properly	Yes. Accumulated Dust to be removed without any maintenance work for Periodically by blowing air a period of not less than ten(10) years
6.0	Approval of Detector	FM of USA, UL of USA, LPCB of U. K. or VDS of Germany
7.0	Cabling	Un armoured PVC Insulated FRLS Cables conforming to IS:1554(Part – 1)

APPENDIX – 5

TECHNICAL DATASHEET

FOR HEAT DETECTOR

1.0	Manufacturer	OPTCL approved vendor
2.0	Principle of Operation	Rate of Rise - cum - Fixed Temperature Type
3.0	Set Point of Operation	5 °C per minute / 55 °C
4.0	Maximum Recommended Spacing	6 metres
5.0	Normal Operating Temperature	-20 °C to 70 °C
6.0	Guaranteed to function properly	Yes. Accumulated Dust to be removed without any maintenance work for a period of not less than ten years periodically by blowing air
7.0	Approval of Detector	FM of USA, UL of USA, LPCB of U.K. or VDS of Germany
8.0	Cabling	Un armoured PVC Insulated FRLS Cables conforming to IS:1554(Part - 1)

APPENDIX – 6

**TECHNICAL DATASHEET
FOR IONISATION SMOKEDETECTOR**

1.0	Manufacturer	OPTCL approved vendor
3.0	Principle of Operation	Ionisation of Air by Radio Active Source
4.0	Radio Active Source	Americium-241
5.0	Maximum Recommended Spacing	9 metres
6.0	Normal Operating Temperature	Minus 10°C to 60°C
8.0	Guaranteed to function properly	Yes. Accumulated Dust to be removed without any maintenance work for a period of not less than ten years periodically by blowing air by blowing air
9.0	Approval of Detector	FM of USA, UL of USA, LPCB of U.K. or VDS of Germany
10.0	Cabling	Unarmoured PVC Insulated FRLS Cables conforming to IS:1554(Part - 1)

APPENDIX – 7

**TECHNICAL DATASHEET
2C x 1.5sq.mm UNARMOURED CABLES**

1	Make	OPTCL approved vendor
2	Type	Control Cable
3.	Number of Cores	Two(2)
4.	Size	1.5sq.mm.
5.	Voltage Grade	1.1kV
6.	Applicable Standard	IS:1554 (Part – 1)
7.	Conductor Material	Plain Annealed Electrolytic Copper
8.	Conductor Construction	Stranded
9	Conductor Resistance	12.1Ω / km at 20 °C
10	Insulation Material	PVC Insulation Type- A as per IS:5831
11	Insulation Thickness	0.8 mm Nominal
12	Identification	Red and Black

13	Inner Sheath Material	PVC Compound Type ST1 as per IS:5831
14	Inner Sheath Thickness	0.3 mm Minimum
15	Outer Sheath Material	PVC Compound Type ST2 as per IS:5381,FR
16	Outer Sheath Thickness	1.8 mm Nominal
17	Outer Sheath Colour	Grey
18	Overall Diameter	As per Manufacturer Design Data

APPENDIX – 8

TECHNICAL DATASHEET FOR MANUAL CALL POINT

1.0	Manufacturer	OPTCL approved vendor
2.0	Construction	Deep Drawn Sheet Steel
3.0	Type	Break Glass with Push Button
4.0	Operating Voltage	24 Volts, DC \pm 10 %
5.0	Type of Control	Pole – NO / NC
6.0	Degree of Protection	IP - 52
7.0	Material of Housing	M.S. 18Gauge
8.0	Colour	FIRE RED
9.0	Accessories	Hammer and Chain Assembly

APPENDIX – 9

**TECHNICAL DATASHEET
FOR FIRE ALARM SOUNDER (HOOTER)**

1.0	Manufacturer	OPTCL approved vendor
2.0	Construction	Deep Drawn Sheet Steel
3.0	Type	Dual Tone /Single Tone
4.0	Operating Voltage	24 Volts, DC ± 10 %
5.0	Output	Not less than 80dB(A) but not more than 120dB(A) at 1.5 metres distance
6.0	Output Frequency Range	500Hz. to 1,000Hz.
7.0	Operating Time	50 minutes (Minimum)
8.0	Material Of Housing.	M.S. 18 Gauge
9.0	Colour	FIRE RED
10.0	Marking	FIRE ALARM

APPENDIX - 10

**TECHNICAL DATA SHEET
FOR GLOBE VALVE**

1.0	Nominal Size in mm.	15 to 40
2.0	Make	To be Approved by OPTCL
3.0	Type	Globe
4.0	Number	As per Approved System Drawings
5.0	Material of construction	
5.1	Body	Bronze to IS:318 Grade LTB 2
5.2	Hand Wheel	Grey Cast Iron, Grade FG200 of IS:210
5.3	Bonnet and Wedge	Bronze to IS:318 Grade LTB2
5.4	Trim	Bronze to IS:318 Grade LTB2
6.0	End Connection	Screwed
7.0	Standard	IS:778
8.0	Rating	PN 1.6
9.0	Hydrostatic Test Pressure	
9.1	Body	24kg/cm ²
9.2	Seat	16kg/cm ²

APPENDIX - 11

**TECHNICAL DATA SHEET
FOR GUN METAL GATE / SLUICE VALVE**

1.0	Nominal Size in mm.	15 to 40	50 to 300
2.0	Make	To be Approved by OPTCL	
3.0	Type	Gate/Sluice	
4.0	Number	As per Approved System Drawings	
5.0	Material of construction		
5.1	Body	Bronze to IS:318 Grade LTB 2	Grey Cast Iron, Grade FG200 of IS:210
5.2	Hand Wheel	Grey Cast Iron, Grade FG200 of IS:210	
5.3	Bonnet and Wedge	Bronze to IS:318 Grade LTB2	Grey Cast Iron, Grade FG200 of IS:210
5.4	Stem	High tensile Brass, Grade HT1 or HT2 of IS:320	Stainless Steel
6.0	End Connection	Screwed	Flanged
7.0	Standard	IS:778	IS:14846
8.0	Rating	PN 1.6	
9.0	Hydrostatic Test Pressure		
9.1	Body	24kg/cm ²	
9.2	Seat	16kg/cm ²	

APPENDIX - 12

**TECHNICAL DATA SHEET
FOR FLOAT OPERATED VALVE**

1.0	Manufacturer	OPTCL approved vendor
2.0	Type	Float Operated Valve
3.0	Size	100 mm
4.0	Quantity	2 Nos.
5.0	Material of Construction	
5.1	Body	Cast Iron (IS:210 FG:200)
5.2	Seat Ring	Gun Metal (IS:318, LTB-2)
5.3	Disc Ring	Gun Metal (IS:318, LTB-2)
5.4.	Spindle	13% Cr. Stainless steel
5.5	Piston	Cast Iron (IS:210, FG:200)
5.6	Lever	Mild Steel (IS:226)
5.7	Float	Tin Coated Copper
5.8	Fulcrum	Mild Steel (IS:226)
5.9	Pilot Valve	Stainless Steel (AISI-304)
5.10	Gland Packing	Graphite Asbestos Rope
5.11	Bonnet	Cast Iron (IS:210, FG:200)
6.0	Hydrostatic Test Pressure	
6.1	Body	15 kg / cm ²
6.2	Seat	10 kg / cm ²
7.0	End Connection	Flanged Connection

APPENDIX - 12

**TECHNICAL DATA SHEET
FOR CHECK VALVES (NON-RETURN VALVES)**

1.0	Make	OPTCL approved vendor
1.1	Type	Swing Check Type
1.2	Standard Followed	IS:5312
1.3	Rating	PN 1.6
1.4	Material of Construction	As per IS: 5312
1.5	Inlet Outlet Details	Flanged
1.6	Hydraulic Test Pressure, kg/cm ²	
1.6.1	Body	24
1.6.2	Seat	16

VENDOR LIST FOR FIRE PROTECTION PACKAGE

S.No.	Equipment/Material	Make
1.	Pumps (Horizontal Centrifugal)	KBL/M&P/B&C
2.	Motors (L.T.) ELECT.IND./GEC	RAJENDRA SIEMENS/ ABB/CROMPTON
3.	Diesel Engine ENGINE LTD	Ruston & Hornsby (Greaves)/ KIRLOSKAR OIL
4.	Air Compressor	KGK/ELGI/INGERSOL RAND
5.	Batteries	EXIDE/AMCO/AMARA RAJA
6.	M.S./G.I Pipes LLOYDMETALS	JINDAL/PRAKASH/ SAIL/ & ENGINEERS LTD.
7.	C. I. Valves	H. Sarkar/ Venus/ Kalpana(Gate & Check)
8.	Gun Metal Valves (Globe)	Leader
9.	Float operated Gate Valve	Levcon /Sigma
10.	Deluge Valve	ACE Turnkey/H.D. Fire
11.	Strainer Grandprix / Jaypee/ Multitex/ (Y-Type & Basket Type)	Gujarat Otofilt
12.	Hume pipe	Indian Hume Pipe/Pargate Concrete Udyog Delhi
13.	H. V. Spray Nozzles	H.D. Fire/ACE Turnkey
14.	Q. B. Detectors	H.D Fire/ACE Turnkey

15.	Pressure Gauge	H. Guru/General Instrument
16.	Pressure Switches	Indfos/Switzer/Verma Trafag
17.	Level Switches	Levcon/Sigma
18.	Level Indicator	Levcon/Sigma
19.	Level Gauge	Levcon/Sigma
20.	Hydrant Valves & Accessories	Sukan/Shah Bhogilal
21.	Hoses (Flax Canvas)	Jayshree Calcutta/Newage
22.	Solenoid Valves	AVCON/ROTEX
23.	Heat & Smoke Detectors Sensor/Nittan	Apollo, U.K. /Pyrotonics /System
24.	Cables	Polycab/PRWE/GEMSCAB/ KEI/PARAMOUNT
25.	Fire Extinguishers	Nitin/Vijay Fire/Lightex/Zenith/ Minimax
26.	Fire alarm Panels	ECD
27.	Annunciators	Peacon/Piri/Procon
28.	Dished Ends	Anoop Engg./Motilal/Kanara
29.	Local control panels & Annunciation panels.	Suchitra/Vikas Engg./UNILEC/JASPER/ MIKA/ Bose corporation.
30.	Response Indicators/Hooters	M.C. Engineering Delhi/

Break Glass Units

Maths, Bombay/ Mehta &
Associates, Ahmedabad.

Part-26

GENERAL SUB STATION LIGHTING SYSTEM

1. GENERAL:

The scope comprises design, engineering, supply, installation, testing and commissioning of the following:

- Complete installation and lighting fixtures complete with lamps, supports and accessories; For indoor and outdoor
- Ceiling fans complete with electronic regulators, accessories;
- lighting panels and lighting poles complete with distribution boxes;
- Galvanised rigid steel conduits and fittings, lighting PVC cables, GI Earth wire receptacles, switchboards, switches, junction boxes, pull out boxes complete with accessories;
- Lighting transformer.
- Any other items required to complete the indoor and outdoor lighting in complete shape.

The details of area to be illuminated are given in Table 1. along with the required lux levels.

Area	Lux
Control Room	350
PLCC Room	300
LT Room	150
Charger Room	150
Cable Gallery	150
Heating Plant	100
Battery Room	100
Computer Room	300
Entrance lobby	150
Corridor and landing	150
Conference and display	300
Rest Room	250
AHU Room	100
DG Set Building	150
Fire Fighting Pump House	150
Switchyard - Main equipment	50
Switchyard - general equipment and balance	30
Street/Road	30

Table 1. Areas to be lit and required lux levels

Contractor shall submit detailed calculation for verifying that the required lux levels will be attained by the proposed lighting system

Any material, cables, wire, conduits, fittings, accessories etc. whether mentioned specifically or not but required for installation of lighting fixtures are included in the scope of Contractor.

2. SYSTEM DESCRIPTION:

2.1 Normal lighting – AC:

AC lights will be connected to AC lighting panels. All the lights connected to the AC lighting system in different areas will be connected to the main lighting distribution boards to be supplied.

2.2 Emergency lighting – AC:

This system will be available in control room building, switchyard and diesel generator building. AC lighting load will be connected to this system which will be normally 'ON'. The lighting panels of this system will be connected to the Emergency lighting board which is fed from diesel generator during the emergency.

2.3 Emergency lighting – DC:

DC emergency lighting fixtures operated from the DC system shall be provided in strategic locations so that the operating personnel can safely find their way during a total AC failure. These lights will be normally 'OFF' and will be switched 'ON' automatically when under voltage occurs in the AC mains lighting distribution board.

2.4 Emergency lighting – portable:

Emergency portable light shall be provided as per relevant clause of this section. Three portable lights for control room and two portable lights for PLCC room shall be provided for every substation.

2.5 Temperature Rise:

All lighting fixtures and accessories shall be designed to have a low temperature rise according to IEC 598 Part-I/ IS 10322 (Part-4). Temperature rise of panels should be as per IS 8623 (Part-1)/IEC 439-1.

3. LIGHTING FIXTURES:

3.1 General:

Fixture shall conform to latest IS / IEC .and its latest amendment.

All fixtures shall be designed for minimum glare. The finish of the fixtures shall be such that no bright spots are produced either by direct light source or by reflection.

All lighting fixtures shall be complete with required lamps such as LED (to be fitted inside switch yard and all street light), & LED light (adopt as per Govt. norms for energy efficiency) for indoor lighting.

LED lamp fixtures shall be complete with all necessary wiring and accessories such as ballasts, ignitors, power factor improvement capacitors etc if required. These shall be mounted in the fitting assembly only. The Contractor shall indicate starting time of these lamps to attain full light output. Curves for starting characteristics with varying supply voltage etc. are to be furnished by the Contractor.

Flood lighting shall have suitable base plate/frame for mounting on structural steel member.

Each fixture (other than bulk head fixtures) shall have terminal blocks suitable for 2.5 mm² stranded flexible copper conductor. The internal wiring should be completed by the manufacturer and terminated on the above terminal blocks. The Contractor shall specifically furnish details of internal size of wires and type of insulation. The terminal blocks shall be as specified under General Equipment and Substation Accessories (GESA) section of this Specification.

Each lighting fixture shall be provided with an earthing terminal suitable for connection to 16 SWG GI earthing conductors.

All metal or metal enclosed parts of the housing shall be suitably constructed so as to ensure satisfactory earthing continuity throughout the fixture up to the earthing terminal.

The mounting facility and conduit knock-outs for the fixtures shall be provided and shall be suitable for 20 mm conduit entry.

On completion of manufacture, all surfaces of the fixtures shall be thoroughly cleaned and degreased. The fixtures shall be free from scale, rust, sharp edges and burrs.

The housing shall be stove-enamelled or vitreous enamelled or anodized aluminium as indicated in the specification of the relevant fixture.

All enamel finishing shall have a minimum thickness of 2 mils for outside surface and 1.5 mils for inside surface. The finish shall be non-porous and free from blemishes, blisters and fading.

The surface shall be scratch resistant and shall show no sign of cracking or flaking when bent through 90 degrees. Over 1.5 inch die mandrel.

All light reflecting surfaces shall have optimum light reflecting coefficient so as to ensure the overall light output as specified.

The different types of lighting fixtures to be provided shall be to the approval of the OPTCL.

REMARKS: ALL THE LAMPS TO BE USED INSIDE & OUTSIDE THE SUB- STATION AREA SHALL BE OF “LED” ONLY. BIDDERS ARE ADVISED TO QUOTE ACCORDINGLY.

3.2 Accessories:

3.2.1 Reflectors:

The reflectors shall be manufactured from sheet steel or aluminium more applicable of not less than 22 SWG thickness. They shall be securely fixed and of captive type.

3.2.2 Lamp holders:

Lamp holders shall preferably be for LED lamps etc.. Holders shall be designed and manufactured in accordance with relevant standard to give long and satisfactory service.

3.2.3 Ballasts(if required):

Ballasts shall be designed, manufactured and supplied in accordance with IS 3021 and function satisfactorily under site condition specified. The ballasts shall be designed to have a long service life. The power loss in ballasts (if required)for LED lamps shall not be more than the specified watts as per relevant standard and for the fluorescent lamps it shall be the minimum commercially available in the industry.

Ballasts shall be mounted using self-locking, anti-vibration fixing and shall be easy to remove without dismantling the fixtures. They shall be totally enclosed units.

The ballasts shall be of the inductive, heavy duty type, filled with thermosetting, insulating, moisture repellent polyester compound filled under pressure or vacuum. The ballast wiring shall be of copper wire. Ballasts shall be designed for maximum winding temperature rise of 55C under rated conditions. They shall be free from hum. Ballasts for LED lamps shall be provided with suitable tapping to set the voltage within the range specified. End connections and taps shall be brought out in a suitable terminal block, rigidly fixed to the ballast enclosure.

Separate ballasts for each lamp shall be provided in case of multi-lamp fixtures.

The Contractor shall submit general arrangement and wiring diagram with all terminal details for approval of the OPTCL.

3.2.4 Capacitors:

Capacitors shall have a constant value of capacitance and shall be connected across the supply of

individual lamp circuits.

Capacitors shall be suitable for operation at the supply voltage as specified and shall have a value of capacitance so as to correct the power factors of its corresponding lamp circuit to the extent of 0.98 lag.

Capacitors shall be hermetically sealed in a metal enclosure.

3.2.5 Lamps:

The LED lamps to be supplied shall conform to IS 9974. LED lamps shall be suitable for use in any position. Restrictions, if any, shall be clearly stated. The lamps shall be capable of withstanding small vibrations without breakage of connections at lead-in wires and filament electrodes.

The constructional features of LED lamps for special applications shall be clearly brought out in the bid.

The Bidder shall furnish typical wiring diagrams for all fittings including all accessories. The diagrams shall include technical details of accessories i.e. ignitors, ballasts, capacitors etc.

3.3 Receptacles:

All receptacles shall be of cast steel or aluminium, heavy duty type, suitable for fixing on wall or column and complete with individual switch.

In general the receptacles to be installed are of the following types:

- Type RO-15A, 240V, 2 pole, 3 pin type with third pin grounded, metal clad with gasket having cable gland entry suitable for 2 core 6 mm² PVC armoured cable and a metallic cover fixed to it with a metallic chain. Receptacles shall be suitable for installation in moist location and/ or outdoor. The switch shall be of rotary type. Receptacles shall be housed in an enclosure made out of 2 mm thick GI sheet with hinged doors with padlocking arrangements. Door shall be lined with good quality gaskets. This shall conform to IP 55.
- Type RI-Combination of 5A and 15A, 240V, 3 pin type with third pin grounded, suitable for flush mounting. The switch shall be of piano key type and shall be flush mounted.
- Type RP-63A, 415V, 3 phase, 4 pin interlocked plug and switch with earthing contacts. Other requirements shall be same as type RO. The receptacle shall be suitable for 3½ core 35mm² / 3½ core 70mm² aluminium conductor cable entry and shall also be suitable for loop-in-loop-out connection of cables of identical size. Receptacle shall be suitable for outdoor application. Receptacles shall be housed in a box made out of 2 mm thick G. I. sheet, with hinged door with padlocking arrangement. Door shall be lined with good quality gaskets. This shall conform to IP 55.

4. LIGHTING POLES:

The Contractor shall supply, the following types of hot dip galvanized steel tubular lighting poles required for street lighting:

- a) Type A1 street lighting pole - for one fixture
- b) Type E1 post top lantern pole - for one fixture

Street/flood light poles shall conform to the drawings approved by the OPTCL.

Lighting poles shall be complete with fixing brackets and junction boxes. Junction boxes should be mounted above ground level at 1 metre height from the ground.

The lighting poles shall be steel hot dip galvanized

The galvanized sheet steel junction box for the street lighting poles shall be completely weather proof conforming to IP 55 and provided with a lockable door and HRC fuse mounted on a fuse

carrier and fuse base assembly. The terminals shall be stud type and suitable for two nos. 16mm² cables. Necessary arrangement for cable glands along with supply of double compression glands are included in Contractor's scope.

Wiring from junction box at the bottom of the pole (minimum height from the bottom of the pole shall be 1.0mtrs) to the fixture at the top of the pole shall be 2.5 mm² wire.

5. LIGHTING WIRES & CABLES:

The wiring used for lighting shall be of 1100V grade, PVC insulated cable of standard products of reputed manufacturers.

The conductor sizes for wires used for point wiring beyond lighting panels shall be single core 4 mm², 6mm² and 10mm² stranded aluminium wires and 2.5 mm² stranded copper wire.

The wires used for connection of a lighting fixture from area rest junction box or for loop-in loop-out connection between two fluorescent fixtures shall be single core copper stranded conductor, 1100V grade flexible PVC insulated cords, unsheathed, conforming to IS 694 with nominal conductor cross sectional areas of 2.5mm².

The Contractor's scope covers supply of all wiring, cabling and accessories. The wires shall be colour coded as follows:

- Red for R - Phase
- Yellow for Y - Phase
- Blue for B - Phase
- Black for Neutral
- White for DC (Positive)
- Grey for DC (Negative)

6. TESTS AND TEST REPORTS:

Type tests, acceptance tests and routine tests for the lighting fixtures and accessories covered by this specification shall be carried out as per the relevant standard for the respective fixtures and their accessories.

Manufacturer's type and routine test certificates shall be submitted for the fixtures and accessories. Type test certificates shall be furnished along with the bid.

Rates for type tests for all types of fixtures and accessories for light fittings as required under relevant section of this specification shall be provided in the relevant price schedules.

7. LIGHTING SYSTEM INSTALLATION WORKS

7.1 General:

In accordance with the specified installation instructions as shown on manufacturer's drawings or as directed by Project Manager. Contractor shall supply, erect, install, test and put into commercial use all the electrical lighting equipment included in the contract. Equipment shall be installed in a neat, work man like manner so that it is level, plumb, square and properly aligned and oriented. Tolerances shall be as established in manufacturer's drawings or as stipulated by Project Manager.

The Contractor shall prepare the lighting layout and erection drawings and obtain the Project Manager's approval before commencing the erection works.

7.2 Flood lights:

Contractor shall install flood lights on switchyard structures to be erected inside switchyard. The GI structural are also suitable for protection from lightening by providing spikes cones at all the column peak. Proper design in this respect to be carried out along with numbers of such towers required. Plotting of lightening protection area showing details of equipment installed in switch yard. A platform provided in the mast tower shall be used for fixing of lighting fixtures.

Fixtures shall be mounted on galvanized making use of shop provided holes or by suitable clamps. No cutting or drilling of galvanized structure is permitted.

The Contractor shall mount the assembled fittings and install necessary cabling.

7.3 Lighting fixtures for flood lights:

Flood lights shall be mounted on steel base facing the tentative direction shown on drawings. Fixing holes shall be provided with slot to turn the fixture by approximately 5 degrees on both sides. Bolts shall be finally tightened with spring washer. The Contractor shall supply and install the steel base, channels, angles etc. for fixing the flood light on the flood light towers. Terminal connection to the flood light shall be through flexible conduits, and these flexible conduits shall be included in the installation rate of fixture itself.

The scope of Contractor shall include the supply of necessary brackets and sundry material, for installation of lighting fixtures.

7.4 Lighting panels:

Lighting panels shall be erected at the locations to be indicated in the approved drawings.

Necessary foundations and/or supporting structures for all outdoor type lighting panels and necessary supporting structures for indoor lighting panels shall be provided by the Contractor.

7.5 Street lighting poles:

Street lighting poles shall be installed as per the approved drawings.

Steel tubular hot dip galvanized poles which are specified for the above purpose are to be installed as per the approved lay out for street lighting system. Contractor shall erect the poles (including foundation works), mount the assembled fittings and install necessary cabling.

8. TECHNICAL PARAMETERS OF LIGHTING TRANSFORMERS

- | | | |
|-------|--|----------------------|
| i) | Type of transformer | Dry type natural air |
| ii) | Rating | 100 kVA or 75kVA |
| iii) | Voltage ratio | 415/415 volts |
| iv) | No. of phase | Three |
| v) | Frequency | 50Hz |
| vi) | Winding connection | Dyn 1 |
| vii) | Class of insulation | B class |
| viii) | Percentage Impedance | 4%, □10% |
| ix) | No. of taps and steps | 5 in steps of 2.5% |
| x) | Reference standard | IS 2026 |
| xi) | Any latest amendment standards of the above. | |

Transformers shall be located in ACDB room, in separate enclosure. Enclosure shall have degree of protection not less than IP 42 as per IS 2147.

9. EMERGENCY PORTABLE LIGHTING FIXTURES:

The portable emergency lighting fixtures supplied shall have a built in battery rated for six hours and be complete with battery chargers and solid state inverters, and be supplied with all necessary supporting brackets of galvanized steel suitable for wall/column mounting.

The portable emergency lighting fixtures shall be of a single unit, completely tropicalised, suitable for prolonged use with no maintenance, and shall light up automatically in the event of failure of normal supply.

The Contractor shall submit schematic along with all details and general arrangement drawing for approval.

10. CEILING FANS AND REGULATORS:

The Contractor shall supply 1400 mm sweep ceiling fans complete with electronic regulator and switch, suspension rod, canopy and accessories.

The Contractor shall supply the switch, electronic regulator and board for mounting switch and electronic regulator.

Winding of the fans and regulators shall be insulated with Class-E insulating material. Winding shall be of copper wire.

Electronic regulator with smooth control shall be provided.

Precautions shall be taken in manufacture of fans and regulators to ensure reasonable degree of silence at all speeds.

Type tests, acceptance tests and routine tests for the fans and regulators shall be carried out as per latest relevant standard.

Fans and electronic regulators shall be from established manufacturers or brands.

11. FOUNDATION AND CIVIL WORKS

All foundations and civil works shall be included in the Contractor's scope of work. Civil works shall be in accordance with the relevant part of this specification.

12. GROUNDING:

All lighting panels, junction boxes, fixtures, conduits etc. shall be grounded in compliance with the provision of I.E. Rules.

Ground connections shall be made from nearest available station ground grid. All connections to ground grid shall be done by arc welding.

Lighting panels shall be directly connected to ground grid by two 50 x 6mm G.S. flats.

A continuous ground conductor of 16 SWG GI wire shall be connected to each panel ground bus. All junction boxes, lighting fixtures shall be connected to this 16 SWG ground conductor.

All lighting poles shall be earthed as per standard. 16 SWG GI wire shall be taken up to junction box from the lighting fixture.

13. TESTING AND COMMISSIONING:

On completion of erection work, the Contractor shall request the OPTCL to undertake the inspection as required by this Specification.

The OPTCL shall arrange for joint inspection of the installation for completeness and correctness of the work. Any defect pointed out during such inspection shall be promptly rectified by the Contractor.

The installation shall be tested and commissioned in the presence of the Contractor and OPTCL

The Contractor shall provide all men, material and equipment required to carry out the tests.

All rectification, repairs or adjustment work found necessary during inspection, testing and commissioning shall be carried out by the Contractor, without any extra cost to the Employer.

The Contractor shall measure and furnish to the Project Manager, the actual lux level in all the areas of the substation to prove compliance to this specification.

**** Armoured PVC cables are to be used for the switch yard lighting, street lighting and any other outdoor lighting system.**

**** For indoor lighting, each fixture shall be controlled by one switch.**

**** Minimum two nos. 5 Amp multipurpose power sockets with switch are to be provided in each switch.**

***** Contractor to furnish the design details for the locations (like Switch yard area, Road street light, Control room building area, Quarter ,Gate etc.), which can be adopted after approval from OPTCL. Design to be carried out as per the LUX level indicated at the beginning of this chapter.**

**TECHNICAL SPECIFICATION FOR LED FLOOD / NORMAL LIGHT FITTINGS 1 PH
A.C OPERATION**

1. GENERAL DESCRIPTION

LED Flood/Normal Light luminaries of 240V, A.C,50 Hz ,suitably decided the wattage of the lamp (to be decided after detail Engineering) in Single piece High Pressure Die Cast Aluminium alloy Housing having high conductivity acting as heat sink, with Powder coating with suitable color with distortion free, clear, Heat Resistant Toughened UV stabilized Glass in the front fixed to the die cast Aluminium frame which shall be fixed to the housing with high quality long lasting Neoprine Rubber gasket duly impregnated with insecticide and water repellent chemical on the periphery of lamp compartment by means of stainless steel screws to render it dust proof, water proof and vermin proof and having minimum IP-65 Protection conforming to IS:10322 (part-2) – 1982.

Note: The capacity LED Luminary is to be suitably decided after conducting the detail engineering for the locations, where these Luminaries are to be used. The Locations are generally in EHV grade Sub-station switch yard area, Street Lighting, Control Room Building, Colony Quarters etc. Details design for adoption of LED Luminary system to be furnished for review of design and its acceptance. Latest practice of adoption of these system are to be strictly followed.

2. TRAINING :

Train the staff on Hardware /Software, installation, commissioning and maintenance of the Luminaries at different locations (Different Sub-stations).

3. TECHNICAL SPECIFICATIONS:

The LED Luminaries are as per the following parameters

a	Mid Power White LED's	Should be of reputed make as Indicated in the Tender specification.
b	Wattage of Mid Power White LED,s offered	Low power LED 5252 0.3W
c	LED Lumens	
d	Life span as per LM70(@70%) light output	>50000 Hrs. Or Better
	Lux at centre at height of 4.5 meter	>150 LUX Or Better
e	Uniformity Ratio (Emin. /Emax.)(mounted at 4.5m height @90°Angle)	>0.35 Or Better
f	Luminary Efficacy	>65 Or Better
g	Control of Distribution	Fully Cutoff
i	Driver current(With Constant Current Driver)	<100mA/LED Or Better
j	Electronic <u>Efficiency@230V</u>	>85% Or Better
k	Beam angle of the Luminary	> 120° Or Better
l	color Temperature of LEDs	6500K to 7500K Or Better
m	P/N junction temperature (High thermal conduction must be achieved by silicon heat conducting greases as adhesive	<85 °C Or Better
n	Luminary Body Temperature	The Body Temperature shall be <(Ambient+35° C) even after continuous burning of Luminary for 24 Hrs. Or Better
o	color Rendering Index(CRI)	>70 Or Better

p	weight	Preferably less weight & may be of Maximum up to 4 Kgs (comfortably can be carried and fixed)
B	ELECTRICAL	
a	AC Input Voltage Range	100V TO 270V AC
b	AC Input frequency .(The LED circuitry shall function at an operating frequency that must be greater than 120 Hz to prevent perceptible flicker to the unaided eye over the entire voltage range specified above.)	47 ~ 53Hz
c	Power Factor (Source Power Factor varies from 0.5 Lag to 0.5 Lead)	> 0.95 Or Better
d	Luminary Wattage variance at 100 V to 270 V	± 10%
e	Luminary Lux Levels Variance at 100 V to 270 V	± 5%
f	Total Harmonic Distortion(THD)	< 15% Or Better
g	Electrical Connection System	3 wire system (Phase, Neutral & Gnd)
h	System of earthing (The luminaries offered shall conform to Level-1 classification)	Solidly grounded
i	There shall be electrical isolation between input and output circuits	
C	MECHANICAL	
a	Construction of Casing	High Pressure Die Cast Aluminum. Should be durable for extreme
b	Finish	Powder Coating and gray/black color and should be durable. The colour should not fade in extreme climate
c	Heat Sink type (It shall be designed in such a way that the heat generated within the LED source is efficiently dissipated to the surrounding atmosphere without abnormal rise in temperature. Any debris build up shall not degrade heat dissipation performance of the luminaries.	Aluminium Metal Core PCB
d	Lamp Cover	Toughened Glass or any suitable material which can be used in the extreme climate and should be durable.

e	Gross Weight and Dimensions (L x W x T) mm of Luminaries (Efforts shall be made to keep the overall outer dimensions as minimum as possible without compromising on the performance, mainly thermal management of the luminary)
f	Heat Dissipating Area (Luminary Rating wise)
g	IP Level –Minimum IP 65

18W AC DOWN LIGHT

DATASHEET:

Applications:

Area: Indoor
Purpose: Home and Office Lighting.

Features:

1. Optical

- Optical pattern meets all standard Home and Office Light Standards.
- Uniform illuminance distribution.

2. Power

- Switched mode constant current power supply.
- Over-heat, Over-voltage, Over-current protections are provided.
- Lightning Protection provided.

3. Thermal

- Luminaire surface temperature is 48°C @ Ta=30°C, the temperature variation is controlled under 5°C.
- Junction temperature is controlled at 70°C @ Ta=30.
- Overheat protection will operate to adjust as the LED module surface reaches 80°C.

4. Luminaire

- Optimized thermal design to ensure maximum life to LED. The Heatsink grade aluminium has the highest surface area for efficient heat diffusion and the entire luminary with Aluminium acts as heat sink.
- Dust and water protection design meeting IP65 standards.
- Super-high luminaire efficacy.

DETAILED TECHNICAL SPECIFICATION

Electrical Characteristics:

PARAMETER	DRIVER RESULT
Input Voltage	160 -300 V AC
Rated Power	18Watt
Maximum Power	21Watt
Efficiency	>85%
Power Factor	>0.9
Voltage Harmonics (THD)	<5%
Current Harmonics (THD)	<10%

Operating Conditions:

Operating Frequency	100kHz to 200KHz
Operating Temperature Range	-25°C to +70°C
Storage Temperature Range	-65°C to 125°C
Humidity	95% RH

LED Details:

Led Make	As per approved vendor
No Of LED's	12
Led Viewing Angle	120° by using reflector
Colour Temperature	Cool White (5500 to 6500K)
Luminous Flux	>2160 Lumens
Life Span	> 80,000 Hours
Colour Rendering Index	>70 Ra

LED Luminary Details:

Body	Aluminum Body
Heat Sink	Optimized thermal design to ensure maximum life to LED. The Heat sink grade aluminium has the highest surface area for efficient heat diffusion and the entire luminary with Aluminium acts as heat sink.
Dust and Water protection	IP 65 Standards

Protection Parameters:

Over-Current Protection	Inbuilt
Short-Circuit Protection	Inbuilt
Over-Voltage Protection	Inbuilt
Over-Temperature Protection	135 °C
Dust and Water Protection	IP 65
Lightning Protection	Inbuilt

50W AC LOW BAY LIGHT

LED bay light fixture is designed and developed to replace traditional high bay or low bay

fixtures for industrial and other rugged applications. Light weighted and easy for installation, the LED High Bay/Low Bay fixtures are all designed to offer maximum energy saving, substantially reduced maintenance costs and superior quality.

Major Applications:

Factory production floors, Workshop, Warehouses, Road toll gates, Petrol stations, Supermarkets, Sports stadiums, Convention center halls, Airport passenger halls, etc., where high ceiling lighting required.

Features:

1. Low power consumption. More than 60% energy saving compared to conventional HID/HPS.
2. Environmental friendly. Lead and mercury free. Long operation life time, above 50,000hours. Low maintenance costs.
3. Voltage input 160-300 V AC,
4. Instant ON/OFF operation.
5. Superior color rendition compared to conventional industrial luminaries.
6. Selectable color temperature.
7. Single piece 30W-100W high power LED light source with unique multi-chip integration design ensure high light purity, high heat conduction and slow brightness derating.
8. Unique heat sink design ensures superior heat management
9. Resistant to shock and vibration.

Specifications:

Input Voltage	AC 160-300V
Power Frequency of Driver	47~63Hz
Power Efficiency of Driver	≥85%
LED Power Consumption	50w
Power Factor(PF)	≥0.90
Total Harmonic Distortion	≤10%
Luminaries Efficiency	≥90%
Flux (Lumens)	4000
Color Rendering Index	≥80
Color Temperature	2700~7000K Optional
Beam Angle	90/120 Degree Optional
Light Effect	70~80lm/W
Working Ambient Humidity	-25°C~+45°C
Working Ambient Humidity	15%~90%RH
IP Rating	IP30/IP54 Optional
Service Life	≥50000 Hours
Light Fixture Material	Aluminum Alloy

100W AC LED STREET LIGHT

DATASHEET:

Applications:

Area: Outdoor

Purpose: Street and Roadway Lighting.

Features:

1. Optical
 - Optical pattern meets all standard Street Light Standards.
 - Uniform illuminance distribution.
2. Power
 - Switched mode constant current power supply.
 - Over-heat, Over-voltage, Over-current protections are provided.
 - Lightning Protection provided.
3. Thermal
 - Luminaries surface temperature is 48°C @ Ta=30°C, the temperature variation is controlled under 5°C.
 - Junction temperature is controlled at 70°C @ Ta=30.
 - Overheat protection will operate to adjust as the LED module surface reaches 80°C.
4. Luminaire
 - Optimized thermal design to ensure maximum life to LED. The Heat sink grade aluminium has the highest surface area for efficient heat diffusion and the entire luminaire with Aluminium acts as heat sink.
 - Dust and water protection design meeting IP65 standards.
 - Super-high luminaire efficacy.

DETAILED TECHNICAL SPECIFICATION:

Electrical Characteristics

PARAMETER	PROMPT DRIVER RESULT
Input Voltage	160 -300 VAC
Rated Power	100W
Maximum Power	115W
Efficiency	>85%
Power Factor	>0.9
Voltage Harmonics (THD)	<5%
Current Harmonics (THD)	<10%

Operating Conditions:

Operating Frequency	100kHz to 200KHz
Operating Temperature Range	-25°C to +70°C
Storage Temperature Range	-65°C to 125°C
Humidity	95% RH

LED Details:

Led Make	As per approved vendor
No of LED's	48-70

Led Viewing Angle	120° by using reflector
Colour Temperature	Cool White (5500 to 6500K)
Luminous Flux	>8500 Lumens
Life Span	> 50,000 Hours
Colour Rendering Index	>70 Ra

LED Luminary Details:

Body	Alluminium Die casting Body
Heat Sink	Optimized thermal design to ensure maximum life to LED. The Heat sink grade aluminium has the highest surface area for efficient heat diffusion and the entire luminary with Aluminium acts as heat sink.
Protection	IP 65 Standards for Dust and Water

Protection Parameters:

Over-Current Protection	Inbuilt
Short-Circuit Protection	Inbuilt
Over-Voltage Protection	Inbuilt
Over-Temperature Protection	135 °C
Dust and Water Protection	IP 65
Lightning Protection	Inbuilt

120/150W AC LED FLOOD LIGHT

DATASHEET:

Applications:

Area: Outdoor
 Purpose: Street and Roadway and Area Lighting.

Features:

1. Optical

- Optical pattern meets all standard Street Light Standards.
- Uniform illuminance distribution.

2. Power

- Switched mode constant current power supply.
- Over-heat, Over-voltage, Over-current protections are provided.
- Lightning Protection provided.

3. Thermal

- Luminaries surface temperature is 48°C @ Ta=30°C, the temperature variation is controlled under 5°C.
- Junction temperature is controlled at 70°C @ Ta=30.
- Overheat protection will operate to adjust as the LED module surface reaches 80°C.

4. Luminaire

- Optimized thermal design to ensure maximum life to LED. The Heat sink grade aluminium has the highest surface area for efficient heat diffusion and the entire luminaire with Aluminium acts as heat sink.
- Dust and water protection design meeting IP65 standards.
- Super-high luminaire efficacy.

DETAILED TECHNICAL SPECIFICATION:

Electrical Characteristics:

PARAMETER	PROMPT DRIVER RESULT
Input Voltage	160 -300 VAC
Rated Power	120W
Maximum Power	140W
Efficiency	>85%
Power Factor	>0.9
Voltage Harmonics (THD)	<5%
Current Harmonics (THD)	<10%

Operating Conditions:

Operating Frequency	100kHz to 200KHz
Operating Temperature Range	-25°C to +70°C
Storage Temperature Range	-65°C to 125°C
Humidity	95% RH

LED Details:

Led Make	As per approved vendor
----------	------------------------

No of LED's	48-70
Led Viewing Angle	120° by using reflector
Colour Temperature	Cool White (5500 to 6500K)
Luminous Flux	>8500 Lumens
Life Span	> 50,000 Hours
Colour Rendering Index	>70 Ra

LED Luminary Details:

Body	Alluminium Die casting Body
Heat Sink	Optimized thermal design to ensure maximum life to LED. The Heat sink grade aluminium has the highest surface area for efficient heat diffusion and the entire luminary with Aluminium acts as heat sink.
Protection	IP 65 Standards for Dust and Water

Protection Parameters:

Over-Current Protection	Inbuilt
Short-Circuit Protection	Inbuilt
Over-Voltage Protection	Inbuilt
Over-Temperature Protection	135 °C
Dust and Water Protection	IP 65
Lightning Protection	Inbuilt

PART-27
HIGH MAST LIGHTING

TECHNICAL SPECIFICATION FOR 30 MTRS HIGH MAST

1. INDEX:

S. No	DESCRIPTION
1.	Technical Specification
2.	GA Drawing of 30mhigh mast
3.	GTP

2. GENERAL:

This specification covers supply, erection, testing & commissioning of 40 Meter for 34 Hectare area & 30 Meters for 5 Hectare area. Lightning cum Lighting Mast System with LED luminaries for 34 Hectare & 5 Hectare area and accessories as well as for installation of lightning protection system.

3. SITE INFORMATION:

The high lighting mast is to be supplied as per Lighting and Lightning Design calculations to achieve appropriate lux level at all places and lightning protection, and shall be suitable for satisfactory continuous operation mentioned in Section Project.

4. STANDARDS:

1	IS 6665: 1972	Code of practice for Industrial lighting
2	IS 6665: 1972	Luminaries –Part 1: General requirements
3	IS 5216-1982	Guide for safety procedures and practice in electrical work
4	IS 325: 1996	Three Phase Induction Motors
5	IS-4691: 1985	Degree of protection provided by enclosure for rotating electrical machinery
6	IS 732: 1982	Code of practice for electrical wiring installation
7	IS 2667-1988	Fittings for rigid steel conduits for electrical wiring
8	IS 9537 Part 1 – 1980	Conduits for Electrical installation
	Part 2 – 1981	General requirements rigid steel conduits
	Part 3 – 1983	Rigid plain conduits of insulating material
	Part 4 – 1983 Reaffirmed 1990	Pliable self-recovering Conduits
9	IS 694: 1990	PVC insulated cables for working voltages up to & including 1100 volts.
10	IS 9046: 1978	AC contactors of voltage above 1000 V upto and including 11000V.

11	IS 1554:1988	PVC Insulated (heavy duty) electrical cables: Part I for working voltages up to & including 1100V
12	IS 4289	Flexible cables for lifts and other flexible connections-Part 1 Elastomer Insulated Cables
13	IS 3618	Phosphate treatment of iron and steel for protection against corrosion
14	IS 2675	Enclosed distribution fuse boards and cut outs for voltages not exceeding 1000 volts
15	IS 13947: 1993	Low voltage switchgear and control gear: General rules
16	IS3043: 1987	Code of practice for Earthing
17	IS 2309: 1989	Code of practice for the protection of buildings and allied structures against lightning.
18	IS2551-1982 FirstRev.Reaffirmed1990	Danger boards
19	I. E Rules	Indian Electricity rules-1956
20	I.S.875 (PART III) -1987	Code and Practice for wind loads.
21	BS code of practice CP-3-chapter V part -II	Gradient of wind speed related to height above ground
22	I.L.E.TR-7, Latest Edition	Specification for Mast /Foundation
23	BS5649, PART-7	Structural Design
24	BSEN 100025/100027, BS 4360 /DIN 17100	Mast Sections
25	IS 2062.	Base plate, Top plate and Accessories
26	BS 5135 or IS 9595	Welding
27	BS 729 / IS 2629/ BS ISO 1461	Galvanizing
28	BIS 3043-1987	Earthing

5. MAST

The high mast shall be continuously tapered, polygonal cross section and 30meters high for 5 Hectare area. The mast shall be fabricated from steel plate welded construction in suitable number of sections (not less than 3), telescopically jointed giving a continuous tapered profile and presenting good visual appearance.

Mast section material shall conform to IS 226 - 1975.

The mast sections shall be hot dipped galvanized both inside and outside conforming to IS: 4759-1984, IS: 2629-1985, IS: 2633-1072.

Mast structure shall be designed to withstand wind speed of 50m/s. with 3 sec. gust conforming IS:

B75 part VIII - 1987 and should have wind load factor 1.25 and material factor 1.15.

The base flange shall be provided with gusset and high tensile anchor bolts.

The bottom most section shall accommodate winch electric drive, cable, plug/socket etc. with a proper door opening in order to permit clear access to the above components. The door shall be dust proof; vermin proof and weather protected (IP 55) and shall be provided with suitable locking arrangement.

Mast shall be provided with lightning protection as per approved drawings to be issued.

Provisions for suitable Earthing shall be provided.

The mast shaft shall be made with best steel in compliance with BS EN 10025 FE 510 having the guaranteed characteristics.

- a. Minimum yield strength = 335 N/Sq. mm for thickness < 30mm.
- b. Tensile strength ranging from 340 to 470 N/sq. mm.
- c. Minimum elongation for thickness between 3 mm and 30 mm.
- d. All holding bolts are hot dip galvanized to BS 729.

6. LANTERN CARRIAGE:

The lantern carriage shall be of steel tubular ring type construction designed to Lamp and accessories in and radically symmetrical fashion

The complete lantern carriage assembly shall be hot dip galvanized after fabrication.

The carriage shall have proper arrangement to avoid swing and to prevent damage to mast surface or other installed parts during lowering/raising operation of carriage.

All hardware used shall have necessary corrosion protection.

Lantern Carriage/Accessories shall be made with best steel in compliance with BS EN 10025 FE 430 A or equivalent having the following guaranteed characteristics.

- a. Minimum yield strength 225 to 250 N/Sq. mm for thickness < 30mm
- b. Tensile strength ranging from 340 to 470 N/Sq. mm.
- c. Minimum elongation 23 to 26%.

Lantern carriages shall accommodate maximum 24nos. 500W LED luminaries.

7. WINCH ASSEMBLY:

Winch assembly, meant for hoisting of lantern carriage shall be fixed in the base of the mast and shall have provision to operate both manually and electrically. The double drum winch should be suitably designed to handle the total weight of lantern carriage assembly with all fittings and accessories with required factor of safety.

The winch shall be of self sustaining and self lubricating type with positive locking arrangement. The rope drum is fabricated as per IS-807 and the wire rope is wound/unwound on double drum winch during movement of lantern carriage.

Particular care shall be exercised in all aspects of design, manufacture, and testing and installation arrangement of the system to ensure optimum safety under all operating condition to give a minimum 25 years of operating life.

Test certificates shall be provided with each winch stating clearly the capacity, operating lubricant, speed and recommended lubricant.

The material of construction for top pulley block shall be non corrosive and preferably made of die cast LM-6 aluminium alloy with self lubricating bearing.

The design shall ensure that the operation of pulley is maintenance free Pulley should be Provided with a weather proof cover.

8. WIRE ROPE:

The wire ropes are flexible marine grade and non corrosive stainless steel.

A minimum 8 turns of wire ropes shall be on the drum when the lantern carriage is fully lowered.

The stainless-steel wire is of minimum 6mm diameter, 7x19 constructions which shall have a factor of safety not less than 5 times the safe working load (SFL) of winch.

9. WINCH DRIVING POWER TOOL:

The winch drive unit shall be squirrel cage reversible induction motor with following characteristic 415V, 3 phase, 50 HZ Class F insulation Weather resistant IP 55 Protections,

The capacity of the electric motor used in power tool shall be compatible to handle the design load of lantern carriage.

The power tool shall be housed at the base of the mast.

For safety reasons and final precision docking of lantern carriage ring, the power tool must have provision to operate manually by using external crank device without removing the drive motor from the winch unit.

10. CONTROL PANEL (FEEDER PILLAR BOX)

A feeder pillar box made of 14 SWG CRCA sheet metal, self supporting, floor mounted, dust, vermin and weather proof for outdoor use shall be supplied for locally/automatically switching' ON/OFF of luminaries.

Detachable gland plate and copper brought out terminals for incoming and outgoing cable connection

Feeder Pillar box to be painted with by 2 coats of primer followed by epoxy grey paint.

Push button for raising and lowering the mobile part shall operate on "Dead man# principal i.e. Action shall cease as soon as the button is released.

Feeder Pillar should be located 5meters radial distance from high mast.

11. ILLUMINATION LEVELS AND CHOICE OF LIGHTING FIXTURES:

1 x 500WLED & 1x 1000W for 30metres high mast respectively with LED light Luminaries lamp and accessories. The Ballast shall be Electronic ballast and degree of protection of the light fitting shall be IP65. Flood Light of 500WLED White Medium beam or Equivalent &Flood Light of 1000W LED and Symmetrical or Equivalent.

12. EARTHING:

The mast shall be provided with lightning protection system comprising of an Earthing system as follows:

- a) The lightning protection arrangement with the finial shall have two down conductors of size 75x10mm GI flat for earthing at the bottom of the mast as per approved drawing.
- b) 2Nos. earth electrodes for Earthing system of high mast lighting system.

13. TOOL BOX:

A tool box of sheet steel containing a set of general and special purpose tools is to be supplied along with high mast.

14. AVIATION OBSTRUCTION LIGHTS

Medium intensity LED aviation obstruction light similar to neon spiral type fitted in a weather- proof box on body unit of Aluminium alloy shall be supplied. The cover of the light will be glass with rubber gasket (IP55 protection). High Luminosity flashing red light emitting diodes having life of 11 years. Power consumption 10 to 15 Watts, 230V AC, 50HZ, 90 candela. LED#s are mounted on fire retardant epoxy printed circuit board in five series- parallel circuits -1Set.

15. FOUNDATION:

Foundation of high mast shall be grillage type considering the Earth Quake resistance measure and it shall be the responsibility of the contractor to design and provide suitable foundation for high mast system.

16. GENERAL CONDITIONS:

Verticality and straightness measurement shall be carried out and these should be within the limits as specified in code of practice

A separate test certificate of the winch shall be submitted.

Supplier's Test Certificate shall be submitted for each reel of rope.

Test certificate of chemical composition and mechanical properties of Sheets and Flange Plates shall be submitted as per the relevant Standards.

Test certificate of Head Frame Assembly, Mast sections, Trailing cable and cable connector as per relevant standards shall be submitted.

Welding and Fabrication detail shall be submitted. These should be as per relevant standard Rules, Regulations and practices.

Principles and details of joints shall be shown on drawings which will be submitted immediately after placement of order.

The thickness of internal and external galvanization shall be as per BS 729 or equivalent IS and a test certificate shall be submitted confirming the same.

Detailed dimensional drawing of the complete Mast including the dimensional details of Base door opening, the distance from the Mast Flange plate to the bottom of the door etc. should be submitted after placement of purchase order.

A drawing with details of Head Frame Assembly complete with Pulley, Guides, Ropes, covering to stop access of birds or other objects/rains etc. and power wiring arrangement should also be submitted after placement of purchase order.

Heat resisting cable shall be used between lamp holders and circuit connection points. Manufacture's Test Certificate as per relevant standard shall be submitted after placement of order.

All components shall be designed to require the minimum of maintenance and skilled attention and also to allow routine maintenance to be carried out quickly and easily with a minimum use of tools.

Every reasonable precaution and provision shall be incorporated in the design of the equipment for the safety and security of the system and of those concerned with its operation and maintenance.

The electrical installation shall comply of all appropriate statutory requirements, rules, regulations, standards and practices.

All metal work including luminaries, control gear units and luminaries carriage shall be bonded to the earth core of the luminaries supply cable. The earth continuity from luminaries' carriage shall be via a single core of the multi-core cable.

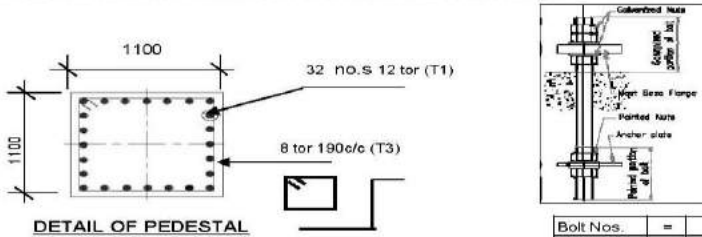
The Mast shall be ventilated. Details by means of which this is achieved shall be submitted after placement of order.

The average rate of raising and lowering shall be not less than 3 meters per minute. Initial quantity of oil for winch shall also be included in the supply

RCC foundation details, design calculations of foundation of high mast, catalogue of high mast and luminaries, illumination level chart shall be submitted for approval.

BEFORE CASTING THE FOUNDATION VERIFY THE DIMENSIONS OF THE FOUNDATION BOLT (DIA. & QTY.) AND ANCHOR PLATE (PCD) WITH RESPECT TO THE DIMENSIONS MENTIONED IN THIS DRG.

FOUNDATION LOADINGS		
WIND SPEED	M/SEC	50
BENDING MOMENT	T-M	21.336
HORIZONTAL SHEAR	T	1.895
VERTICAL LOAD	T	1.869
MAX GR BEARING PRESSURE	T/Sqm	7.760
SAFETY FACTOR AGAINST OVERTURNING		2.168
CONCRETE MIX VIBRATED		M-20
MIN COVER [MM.]		50
STEEL		Fe-415
SOIL BEARING CAPACITY	T/Sqm	10.00
PROJECTED AREA	Sqm	0.464

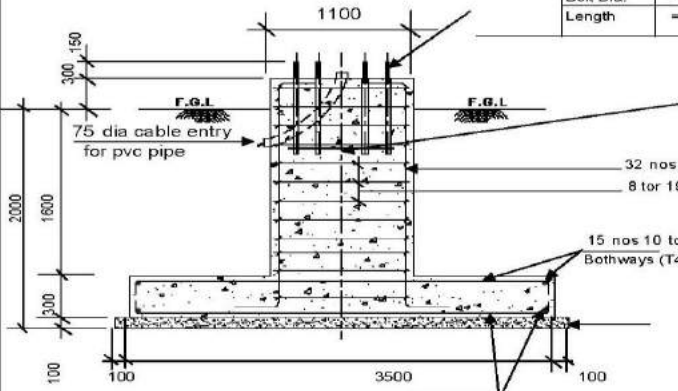


Bolt Nos.	=	12
Bolt Dia.	=	30 mm
Length	=	850 mm

QUANTITIES

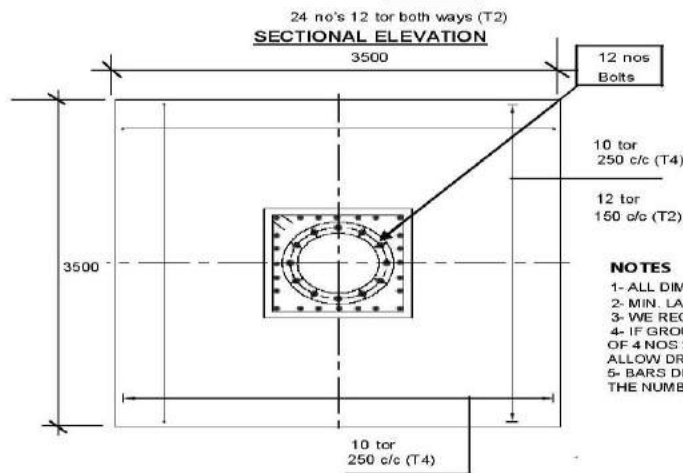
RCC IN CUM	PCC IN CU	STEEL IN KGS
5.97	1.37	324

Anchor Pl. Thk.(mm)	=	8
PCD (mm)	=	850 mm
Nos.of hole/Dia.(mm)	=	12 / 32



BAR BENDING SCHEDULE

MK	QTY	SIZE	LENGTH	SHAPE
T1	32	12	2495	
T2	48	12	3640	
T3	12	8	4192	
T4	30	10	3600	



NOTES

- 1- ALL DIMENSIONS ARE IN MM. DO NOT SCALE THE DRAWING
- 2- MIN. LAP LENGTH OF BARS SHALL BE 60xD, UNLESS OTHERWISE STATED.
- 3- WE RECOMMENDED THAT MAST FLANGE REMAIN UNGROUTED
- 4- IF GROUTING IS CARRIED OUT IT IS ESSENTIAL TO LEAVE A MINIMUM OF 4 NOS 25MM DIA DUCTS EQUALLY SPACED AROUND THE FLANGE TO ALLOW DRAINAGE AND VENTILATION
- 5- BARS DRAWN IN THE DRAWING ARE FOR ILLUSTRATION ONLY. REFER TO THE NUMBERS SHOWN FOR ACTUAL REINFORCEMENT QUANTITY.

DATA SHEET FOR 30 MTR HIGH MAST

Sl. No.	DESCRIPTION	PARAMETERS
1	HIGHMAST SYSTEM	
	Height of mast	30Mtrs
	No. of Sections	Three
	Material construction for shaft	
	Make	
	Thickness Top Middle Bottom	4mm 4mm 6mm
	No. of longitudinal welds /section	One
	No. of circumferential welds/ section	None
	Length of individual sections Top Middle Bottom	9290mm 10980mm 10980mm
	Cross section of Mast	20-sided polygon
	Base dia. and top diameter (A/F) Top diameter Bottom diameter	150mm 540mm
	Type of joints	Stress fit at site (Slip -stress & fit method)
	Length of overlap Top Middle	500mm 750mm
	Metal protection treatment for mast sections	Hot Dipped Galvanised (Both internally and externally)
	Method of hot dipping	Single Dipping
	Average thickness of galvanisation Bottom section Middle & top section	Hot Dipped Galvanised 85micron 65micron
	Size of opening and door at base	1200x250 Vandal resistant with pad locking arrangement and two no Allen bolts
	Diameter of base plate	730mm

	Thickness of base plate	30mm
	Size of anchor plate and thickness	650 PCD, 730x730x8mm
	Lightning protection finial	G.I single spike of length 1200mm
	Foundation bolt	12 Nos of 30mm dia, 850mm Length, TS 600
	Design wind speed	50m/s
2	WINCH	
	Make	
	Number of drums/winches	Double drum type
	Gear Ratio	53:1
	Capacity	750 kgs
	Method of operation	Manual/ Electrical
	Lubrication arrangement	Permanent oil bath
	Type of lubricant	SAE 90. /SAE 140
3	LANTERN CARRIAGE	
	Material of construction	50 NB ERW Class B - M. S. Pipe
	Diameter of carriage ring (mm)	ID 711 mm
	Construction	Welded
	Number of joints	Two
	Buffer between carriage & mast	PVC sleeve on carriage
	Load carrying capacity	750Kgs. (including Carriage)
	Type of Fixture	24nos of 500W LED
4	CABLE	
	Make	
	Type	Trailing cable
	Material	EPR insulated and PCP sheathed
	Conductor size and Current Carry Capacity	2.5 sq. mm./ 24 A
	No. of cores	5 no's
	No. of circuits	One
5	STAINLESS STEEL WIRE ROPE	
	Make	B.W.R.LTD /SSWRPL
	Grade	AISI 316
	Number of ropes	2 Rope system

	Construction	7/19
	Centre core material	Stainless steel core
	Diameter	6 mm
	Braking load capacity	Minimum. 2350 kgs. X 2
	Factor of safety	>5 for system at full load
6	POWER TOOLS	
	Model	Integral
	Make	HEM
	Input supply	3 Ph 440 Volts
	Wattage / HP	1.5 HP
	RPM	895 to 920
	No of pole	6 poles
7	TORQUE LIMITERS	
	Lifting capacity	Up to 750 kgs
	Adjustable/ Non-adjustable	Adjustable
	Tripping device	Mechanical

(to be filled by vendor)

Sl. No.	DESCRIPTION		30 M HIGH MAST
1	HIGHMAST SYSTEM		
	Height of mast		
	No. of Sections		
	Material construction for shaft		
	Make		
	Thickness Top Middle Bottom		
	No. of longitudinal welds /section		
	No. of circumferential welds/ section		
	Length of individual sections Top Middle Bottom		

	Cross section of Mast		
	Base dia. and top diameter (A/F) Top diameter Bottom diameter		
	Type of joints		
	Length of overlap Top Middle		
	Metal protection treatment for mast sections		
	Method of hot dipping		
	Average thickness of galvanisation Bottom section Middle & top section		
	Size of opening and door at base		
	Diameter of base plate		
	Thickness of base plate		
	Size of anchor plate and thickness		
	Lightning protection finial		
	Foundation bolt		
	Design wind speed		
2	WINCH		
	Make		
	Number of drums/winches		
	Gear Ratio		
	Capacity		
	Method of operation		
	Lubrication arrangement		
	Type of lubricant		
3	LANTERN CARRIAGE		
	Material of construction		
	Diameter of carriage ring (mm)		
	Construction		
	Number of joints		

	Buffer between carriage & mast		
	Load carrying capacity		
	Type of Fixture		
	Aviation Fixture		
4	CABLE		
	Make		
	Type		
	Material		
	Conductor size and Current Carry Capacity		
	No. of cores		
	No. of circuits		
5	STAINLESS STEEL WIRE ROPE		
	Make		
	Grade		
	Number of ropes		
	Construction		
	Centre core material		
	Diameter		
	Braking load capacity		
	Factor of safety		
6	POWER TOOLS		
	Model		
	Make		
	Input supply		
	Wattage / HP		
	RPM		
	No of pole		
7	TORQUE LIMITERS		
	Lifting capacity		
	Adjustable/ Non-adjustable		
	Tripping device		

Part-28
STANDARD CIVIL WORKS

TECHINCAL SPECIFICATION FOR CIVIL WORKS

CLAUSE No.	DESCRIPTION
1	CHAPTER–I: TECHNICAL SPECIFICATION – GENERAL
2	CHAPTER–II: DETAILED TECHNICAL SPECIFICATION

CHAPTER – I

TECHNICAL SPECIFICATION – GENERAL

CLAUSE No.	DESCRIPTION
1.1	GENERAL
1.2	QUANTITIES
1.3	QUALIFYING REQUIREMENT
1.4	STANDARDS
1.5	BID PROPOSAL
1.6	DRAWINGS, CATALOGUES ETC.
1.7	STORAGE

CHAPTER – I
TECHNICAL SPECIFICATION- GENERAL

1.1 GENERAL:

1.1.1 SCOPE:

The Scope of this Specification covers Design, Engineering, and Construction of all Civil Works but not limited to the items mentioned below:-

- Geotechnical Investigation and Site Development (Completely levelled land shall i.e. up to FGL shall be handed over to the successful Bidder, however in case of minor cutting & filling (if required), the quantities towards the same are mentioned in the Price Schedule.
- Soil Investigation
- Control Cum GIS Buildings including Water Supply and Sanitary Fittings, E. I. Equipment
- Cable Trenches
- Drainage, Fencing and Boundary Wall along Employer's Property Line and Sub Station Boundary including Gates etc
- Bituminous Road and Culverts within Sub Station Boundary Wall
- Laying of Sewers, Storm Water Drains, Water Supply Lines etc
- Construction of Septic Tank and Soak Pit etc, if Municipal Sewer Line is not available
- Construction of Soak Pit and Sump well along with drain pipe for collecting Oil / Rain Water from Soak Pits of Transformer
- Construction of RCC Type Overhead Tank of suitable capacity to meet the requirement for Control Room Cum GIS Building.
- All the required Accessories, Documents and another Items whether specified here in or not shall be in the Scope of the Bidder. Stores shall be maintained by the Bidder at Sub Station Site in the area to be provided by Purchaser.

The Successful Bidder / Bidder shall also be required to carry out the following:- a)

Estimating the requirements of all Items of Supply including the requirement of

- a) Cement, Reinforcement Steel, Structural Steel, Bricks, Water Supply and Sanitary Fittings Items, E. I. Items in consultation with Purchaser, regarding its ISI / ISO Specification etc for various Work area the requirement of Trench Crossing of Road.
- b) Preparing Detailed Drawings for Structures etc (wherever required), Submission of computation of Structural Drawings to Purchaser duly authenticated with reference to Books, ISI Codes and Manuals followed in referred Designs.

1.1.2 All Materials shall be of best quality conforming to relevant Indian Standards code

- 1.1.3 In case any Item is not covered under Specification then the same shall be carried out as per CPWD/OPTCL Specification and applicable Standards and Codes.
- 1.1.4 In case of any conflict between Standards / Code and Technical Specification, the provisions of Technical Specification shall prevail.
- 1.1.5 The Bidder shall furnish all labour, tools, equipment, materials, temporary works, constructional plant and machinery, fuel supply, transportation and all other incidental items not shown or specified but as may be required for complete performance of the Works in accordance with Specifications and direction of Owner.
- 1.1.6 All Materials Including Cement, Reinforcement Steel, and Structural Steel etc shall be arranged by the Bidder. All Testing required should be arranged by the Bidder at his own cost.
- 1.1.7 The Bidder shall fully apprise himself of the prevailing conditions at the proposed Site. Climatic Conditions including monsoon patterns, Local Conditions and Site Specific Parameters and shall include for all such conditions and contingent measures in the Bid, including those which may not have been specifically brought out in the Specifications.

1.2 QUANTITIES:

The Quantities mentioned in the Bill of Material are provisional. Since, these Quantities are on provisional basis and shall be finalized during Detailed Engineering; the Purchaser reserves the right to vary the quantities after Detailed Engineering.

1.3 QUALIFYING REQUIREMENT:

The Bidder / Manufacturer who offers Services should have executed Civil Works involving all the Works mentioned above for at least two numbers 220 kV or above Sub Stations.

1.4 STANDARDS:

- 1.4.1 The Design, Execution, and Performance of the Works shall comply with all currently applicable Standards, Regulations, and Safety Codes in the Locality where the Works shall be carried out. Nothing in this Specification shall be construed to relieve the Bidder of these responsibilities.
- 1.4.2 Civil works shall be designed to the required service conditions and /or loads as specified elsewhere in this Specification or implied as per National and International Standards.

- 1.4.3 A list of code of practice and standards used for civil works in general is enclosed for reference. In case of any conflict between I.S. Code and the Procedures specified herein, the later shall prevail.

1.5. BID PROPOSAL:

The Bidder shall submit the following with the offer: -

- a) Copy of Valid Registration showing Class - 1 Civil Bidder registered with the ODISHA State Government (if registered)
- b) Experience Details
- c) Proposed Schedule of Work clearly indicating the Time taken by each activity

1.6 DRAWINGS, CATALOGUES ETC:

Detail of Drawings to be submitted after the Award of the Contract: -

- a) Principal Dimensional Details of each Item showing Plan, Elevation and End View
- b) Detailed Drawings, Design Calculations along with supporting authenticated Documents
- c) Any other Drawings and Documents required for approval
- d) Foundation Drawings, Design Calculations along with supporting authenticated Documents

1.7 STORAGE:

Bidder is responsible for the proper Storage and Maintenance of all Materials / Equipments entrusted to him. The Bidder shall provide and construct adequate Storage Shed for proper storage of Materials. Sensitive Material such as Cement shall be stored Indoors as per IS Practice. All Material during Storage shall be protected against damage due to Acts of Nature or Accidents. Bidders shall take all required steps to carryout subsequent inspection of Materials Stored as well as Erected until the same are Taken Over by the Purchaser / Engineer. The Storage Instructions of the Material Supplier / Purchaser shall be strictly adhered to. Proper Handling Equipments are to be provided by the Bidder. Bidder shall indicate in Bid, the Tools, and Plant he will be mobilizing to Site for Handling during Storage, Execution, and Testing Tools at Site at the time of Site Opening. This List will be furnished in the Bid.

CHAPTER – II
DETAILED TECHNICAL SPECIFICATION

CLAUSE No.	DESCRIPTION
1.0	GENERAL
2.0	SOIL INVESTIGATION
3.0	SITE PREPARATION
4.0	ANTIWEED TREATMENT AND SITE SURFACING
5.0	SITE DRAINAGE
6.0	ROADS AND CULVERTS
7.0	POWER TRANSFORMER FOUNDATION, RAIL TRACK / ROAD - CUM - RAIL TRACK
8.0	FIRE PROTECTION WALLS
9.0	CABLE AND PIPE TRENCHES
10.0	FOUNDATION / RCC CONSTRUCTION
11.0	BRICK WALL PANELLED / CHAIN LINK FENCE AND GATES
12.0	BUILDINGS - GENERAL REQUIREMENT
13.0	STORM WATER DRAINAGE
14.0	MISCELLANEOUS GENERAL REQUIREMENTS
15.0	TECHNICAL DETAILS OF THE BUILDING
16.0	INTERFACING
17.0	WATER SUPPLY
18.0	SEWERAGE SYSTEM
19.0	STATUTORY RULES
20.0	MODE OF MEASUREMENT

CHAPTER – II DETAILED TECHNICAL SPECIFICATION

1.0 GENERAL:

1.1 The Intent of Specification covers the following: -

Design Engineering and Construction of all Civil Works at 220/33kV TFL Sub- Station. All Civil Works shall also satisfy the General Technical Requirements specified in other Sections of this Tender Document and as detailed below. They shall be designed to the required Service Conditions / Loads as specified elsewhere in this Tender Document or implied as per National / International Standards.

1.2 All Civil Works shall be carried out as per applicable Indian Laws, Standards, and Codes. All Material shall be of best quality conforming to relevant Indian Standards and Codes.

1.3. The Bidder shall furnish all Design, Drawings, Labour, Tools, Equipment, Materials, Temporary Works, Constructional Plant and Machinery, Fuel Supply, Construction Power, Transportation and all other Incidental Items not shown or specified but as may be required for complete performance of the Works in accordance with Approved Drawings, Specifications and Direction of the Purchaser.

2.0 SOIL INVESTIGATION:

2.1 GENERAL:

The Contractor shall perform a detailed soil investigation to arrive at sufficiently accurate general as well as specific information about the soil profile/strata and the necessary soil parameters of the site in order that the foundations of the various structures can be designed and constructed safely and rationally. Foundation systems adopted by the contractor shall ensure that relative settlement shall be as per provision in IS 1904 and any latest IS and other Indian Standards

This Specification covers all the work required for detailed soil investigation and preparation of a detailed report. The work shall include mobilization of necessary equipment, provision of necessary engineering supervision and technical personnel, skilled and unskilled labour etc., as required to carry out field investigation and tests, laboratory tests, analysis and interpretation of data and results, preparation of detailed soil report including specific recommendations for the type of foundations and the safe bearing capacity for different sizes of foundations at different founding strata for the various structures of the substation.

The Contractor shall make his own arrangements for locating the coordinates and various test positions in field and also for determining the reduced level of these locations with respect to the bench mark .All the test are to be carried out before the OPTCL officials or before any agency engaged by OPTCL. Prior intimation in this

effect has to be given to OPTCL.

A report to the effect will be submitted by the Contractor for the Engg. Incharge (Divisional Engr.) specific approval giving details regarding his assumed data for Civil structures design.

Any variation in soil data shall not constitute a valid reason for any additional cost and shall not affect the terms and condition of the Contract. Nothing extra what so ever shall be paid to the Contractor on account of any variation in subsoil properties /or conditions. Tests must be conducted under all the critical locations i.e. Control room building, autotransformer, lightning mast, 400 kV/220 kV/132 kV column location etc. However, some of the soil parameters given below for substations have to be determined and submitted to Engg Incharge (Divisional Engr.).

- Dry density
- Bulk density
- Angle of internal friction/cohesion
- Specific gravity
- Natural moisture content.

2.2 **BORE HOLES:**

Drilling of a specified number of bore holes of 150 mm dia. in accordance with the provisions of IS 1892 at approved locations to specified depths or to refusal whichever occurs earlier. (By refusal it shall mean that a standard penetration blow count (N) of 100 is recorded for 30 cm penetration). However, at least 3 boreholes shall be drilled to the required depth (15 mts approximately).

Performing Standard Penetration Tests at approximately 2.0 m intervals in the bore hole starting from 0.5 m below ground onwards and at every change of stratum. The disturbed samples from the standard penetrometer shall also be collected for Necessary tests.

Collecting undisturbed samples of 100/75 mm diameter 450 mm long from the bore holes at intervals of 2.5 m and every change of stratum starting from 1.0 m below ground level onwards.

The depth of Water Table shall be recorded in each bore hole. All samples, both disturbed and undisturbed, shall be identified properly with the bore hole number and depth from which they have been taken. The sample shall be sealed at both ends of the sampling tubes with wax immediately after the sampling and shall be packed properly and transported to the Contractor`s laboratory without any damage or loss.

The logging of the bore holes shall be compiled immediately after the boring is completed and a copy of the bore log shall be handed over to the Engg Incharge.

2.3 DYNAMIC CONE PENETRATION TEST:

Two Dynamic cone penetration tests under the locations of auto transformers shall be carried out with the circulation of bentonic slurry at specified location and a continuous record of penetration resistance (NG) upto 15 metre from natural ground level or refusal shall be maintained by the Contractor.

Dynamic cone penetration tests are conducted to correlate engineering properties such as stratification density, bearing capacity, settlement, etc., of soils which are primarily cohesive in nature. The tests shall be conducted by driving a standard size cone attached loosely or screwed to a string of drill rods. The specification for the equipment and accessories required for performing this test, test procedure, field observations and reporting of results shall confirm to IS 4968 part 11 latest revision the driving system shall comprise of 65 kg weight having a free fall of 75 cm. The cone size shall be 65 mm diameter, and provided with vents for continuous flow of bentonite slurry through the cone and rods in order to avoid friction between the rods and soil. The location for tests shall be as directed by the Engg Incharge (Divisional Engr.). On completion of the test, the results shall be presented as a continuous record as the number of blows required for every 300 mm penetration of the cone into the soil.

2.4 TRAIL PITS:

Trial pits shall be made at two locations as approved by the Engg Incharge (Divisional Engr.). The trial pits shall two metres square in size extending to (four) metres depth or as specified by the Engg Incharge (Divisional Engr.). Undisturbed Samples shall be taken from the trial pits as per the direction of the Engg Incharge (Divisional Engr.).

2.5 FIELD CALIFORNIA BEARING RATIO TEST:

This test shall be carried out to obtain the properties of soil required for the construction of roads. The equipment and accessories required for carrying out the test, test procedure, recording of observations and presentation of results shall confirm to IS 2770 part XXXI.

The test locations of CBR test shall be on the road locations as per GA drawing. These tests shall be performed on remolded and undisturbed, soaked and un soaked samples.

2.6 ELECTRICAL RESISTIVITY TEST:

This test shall be conducted to determine the electrical resistivity of soil required for designing safety grounding system for the entire station area. The specifications for the equipment and other accessories required for performing electrical resistivity test, the test procedure, and reporting of field observations shall confirm to IS 3043. The test shall be conducted using Wagner's four electrode method as specified in IS 1892, Appendix-B2. Unless otherwise specified at each test

Location the test shall be conducted along two perpendicular lines parallel to the coordinate axis.

2.7 **PLATE LOAD TEST:**

Plate load test shall be conducted to determine the bearing capacity and load/settlement characteristics of soil at shallow depths by loading a plane and level steel plate kept at the desired depth and measuring the settlement under different Loads, until a desired settlement takes place or failure occurs. The specification for the equipment and accessories required for conducting the test, the test procedure, field observations and reporting of results shall conform to IS 1888.

The location and depth of the test shall be given by the Contractor and approved by the Engg Incharge (Divisional Engr.). Undisturbed tube samples shall be collected at 1.0 m and 2.5 m depths from the natural ground level for carrying out laboratory tests. The size of the pit shall not be less than five times the plate size and shall be taken upto the specified depth. All provisions regarding excavation and visual examination of pit shall apply here.

If the ground water table is at a depth higher than the specified test depth, the ground water table shall be lowered and maintained at the test depth for the entire duration of the test. Dewatering shall be at Contractor`s cost.

Unless otherwise specified the reaction method of loading shall be adopted. Settlement shall be recorded from dial gauges placed at four diametrically opposite ends of the test plate. The test plate shall be 600 x 600 mm size and at least 25mm Thick The bottom of the pit shall be levelled before placing the plate in position for conducting the test.

A seating load of 70 gm/sq.cm shall be applied and after the dial gauge readings are stabilized, the load shall be released and the initial readings of the dial gauges recorded after they indicate constant reading. The load shall be increased in Stages These stages shall be 20, 40, 70, 100, 150, 200, 250, 300, 400. 500, 600 and 800 KN per sqm. or as directed by the Engg Incharge (Divisional Engr.). Under each loading stage, record of time versus settlement shall be kept as specified in IS 1888.

The load shall be maintained for a minimum duration of one hour or till the settlement rate reduces to 0.02 mm/m.No extrapolation of settlement rate from periods less than one hour shall be permitted.

Loading shall be carried out in stages as specified above till one of the following conditions occurs:

- Failure of the soil under the plate i.e. the settlement of the plate at constant load becomes progressive and reaches a value of 40 mm or more.
- Total settlement of the plate is more than 40mm.
- Load intensity of 800 kN/sq.m reached without failure of the soil.

Backfilling of the pit shall be carried out as per the directions of the Engg Incharge (Divisional Engr.). Unless otherwise specified the excavated soil shall be used for this purpose. The quoted rates shall include backfilling.Dial gauge readings for settlement shall generally be taken at 1, 2, 4, 6, 9, 16, 25, 60, 90 and 120 minutes from the

commencement of each stage of loading. Thereafter the readings shall be taken at hourly intervals upto a further four hours and at two hours intervals thereafter for another six hours.

2.8 WATER SAMPLE:

Representative Samples of Ground Water shall be taken when Ground Water is first encountered before the addition of water to aid drilling of Boreholes. The Samples shall be of sufficient quantity for Chemical Analysis to be carried out and shall be stored in Air Tight Containers.

2.9 LABORATORY TEST:

The Laboratory Tests shall be carried out progressively during the Field Work after sufficient numbers of Samples have reached the Laboratory in order that the Test Results of the initial Boreholes can be made use of in planning the later stages of the Field Investigation and quantum of Laboratory Tests.

All Samples brought from Field, whether Disturbed or Undisturbed shall be extracted, prepared and examined by competent Technical Personnel, and the Test shall be carried out as per the procedures laid out in the latest edition of the relevant IS Codes. All the tests shall be performed at NABL accredited laboratories and after seeking prior approval from the Employer.

The following Laboratory Test shall be carried out: -

- a) Visual and Engineering Classification
- b) Liquid Limit, Plastic Limit and Shrinkage Limit
- c) Natural Moisture Content, Bulk Density and Specific Gravity
- d) Grain Size Distribution
- e) Unconfined Compression Test
- f) Unconsolidated Undrained Test
- g) Swell Pressure and Free Swell Index Determination
- h) California Bearing Ratio
- i) Consolidated Undrained Test
- j) Consolidated
- k) Chemical Tests on Soil and Water to determine Drained Test the Carbonates, Sulphates, Nitrates, Chlorides, Ph Value and Organic Matter and any other Chemical harmful to the Concrete Foundation
- l) Rock Quality Designation (RQD), RMR in case of Rock is encountered

2.3.9 TEST RESULTS AND REPORTS:

Contractor shall submit the detailed report in four (4) copies wherein information regarding the geological detail of the site, summarized observations and test data, bore logs, and conclusions and recommendations on the type of foundations with supporting calculations for the recommendations. Initially the report shall be submitted by the Contractor in draft form and after the draft report is approved, the final report in eight (8) copies shall be submitted

The Report shall be including, but not limited to the following: -

- a) A Plan showing the Locations of the Exploration Work i.e. Boreholes, Dynamic Cone Penetration Tests, Trail Pits, Plate Load Test etc.
- b) Bore Logs: Bore Logs of each Borehole clearly identifying the Stratification and the Type of Soil Stratum with depth. The Values of Standard Penetration Test (SPT) and the depths where the Tests were conducted on the Samples collected at various depths shall be clearly shown against that particular Stratum.

Test Results of Field and Laboratory Tests shall be summarized Strata Wise as well in combined Tabular Form. All Relevant Graphs, Charts, Tables, Diagrams and Photographs, if any, shall be submitted along with Report. Sample illustrative reference calculations for Settlement, Bearing Capacity, and Pile Capacity shall be enclosed.

RECOMMENDATIONS:

The Report should contain Specific Recommendations for the Type of Foundation for the various Structures envisaged at Site. The Bidder shall acquaint himself about the Type of Structures and their functions from the Purchaser. The Observations and Recommendations shall include but not limited to the following: -

- a) Geological Formation of the Area, Past Observations or Historical Data, if available, for the Area and for the Structure in the nearby Area, Fluctuations of Water Table
- b) Recommended Type of Foundations for various Structures. If Piles are recommended, the Type, Size and Capacity of Pile and Groups of Piles shall be given after comparing different types and sizes of Piles and Pile Groups.
- c) Allowable Bearing Pressure on the Soil at various depths for different sizes of the Foundations based on Shear Strength and Settlement Characteristics of Soil with Supporting Calculations. Minimum Factor of Safety for calculating Net Safe Bearing Capacity shall be taken as per relevant IS Code. Recommendation of Liquefaction Characteristics of Soil shall be provided.

- d) Recommendations regarding Slope of Excavations and Dewatering Schemes, if required.
- e) Comments on the Chemical Nature of Soil and Ground Water with due regard to deleterious effects of the same on Concrete and Steel and Recommendations for Protective Measures.
- f) If Expansive Soil is met with, recommendations on removal or retainment of the same under the Structure, Road, Drain etc shall be given. In the latter case Detailed Specification of any Special Treatment required including Specification of Materials to be used, Construction Method, Equipments to be deployed etc shall be furnished.
- g) Recommendations for Additional Investigations beyond the Scope of the present Work, if considered such investigation as necessary.
- h) In case of Foundation in Rocky Strata, Type of Foundation and Recommendation regarding Rock Anchoring etc should also be given.

3.0 SITE PREPARATION:

Bidder will have to develop the Land for the entire Scope of Work including the provision for Future Bays specified in Section - 1 (Project). The Layout and Levels of all Structures etc shall be made by the Bidder at his own Cost from the General Grids of the Plot and Benchmarks set by the Bidder and approved by the Purchaser. The Bidder shall provide all assistance in Instruments, Materials, and Personnel to the Purchaser for checking the Detailed Layout and **the Bidder shall be solely responsible for the correctness of the Layout and Levels.**

3.1 SCOPE:

This Clause covers the Design and Execution of the Work for Site Preparation, such as clearing of the Site, the Supply and Compaction of Fill Material, Excavation and Compaction of Backfill, Foundation, Road Construction, Drainage, Trenches and Final Topping by Gravel (Broken Hard Stone) etc.

3.2 GENERAL:

- 3.2.1. The Bidder shall develop the Site Area to meet the requirement of the intended purpose. The Site Preparation shall conform to the requirements of relevant Sections of this Specification or as per stipulations of Standard Specifications.
- 3.2.2. The Fill Material shall be suitable for the above requirement. The Fill shall be such a Material and the Site so designed as to prevent the erosion by Wind and Water of Material from its final compacted position or the in - situ position of Undisturbed Soil.
- 3.2.3. Material unsuitable for founding of Foundations shall be removed and replaced by suitable Fill Material to be approved by the Purchaser.
- 3.2.4. Backfill Material around Foundations or other Works shall be suitable for the purpose

for which it is used and compacted to the density described under compaction. Excavated Material not suitable or not required for Backfill shall be disposed off in Area's as directed by the Purchaser upto a maximum lead of 2.0 km.

3.3 EXCAVATION AND BACKFILL:

3.3.1 Excavation and Backfill for Foundations shall be in accordance with the relevant Code.

3.3.2 Whenever Water Table is met during the Excavation, it shall be dewatered and Water Table shall be maintained below the bottom of the Excavation Level during Excavation, Concreting, and Backfilling.

3.3.3 When Embankments are to be constructed on slopes of 15 % or greater, Benches or Steps with Horizontal and Vertical Faces shall be cut in the Original Slope prior to placement of Embankment Material. Vertical Faces shall measure not more than 1.0 meter in height.

3.3.4 Embankments adjacent to Abutments, Culverts, and similar Structures shall be constructed by compacting the Material in successive uniform horizontal layers not exceeding 15 cm in thickness (of Loose Material before Compaction). Each Layer shall be compacted as required by means of Mechanical Tempers approved by the Purchaser. Rocks larger than 10 cm in any direction shall not be placed in embankment adjacent to Structures.

3.3.5 Earth Embankments of Roadways and Site Areas adjacent to Buildings shall be placed in successive uniform horizontal layers not exceeding 20 cm in thickness in loose stage measurement and compacted to the full width specified. The Upper Surface of the Embankment shall be shaped to provide complete drainage of surface water.

3.4 COMPACTION:

3.4.1 The Method and Equipment used to compact the Fill Material shall be suitable to achieve the density that will give the allowance Solid Bearing Pressure required for the Foundations, Roads etc., in each layer of Fill Material. Each Layer of Earth Embankment when compacted shall be as close to optimum moisture content as practicable. Embankment Material, which does not contain sufficient moisture to obtain proper compaction, shall be wetted. If the Material contains any excess of moisture, then it shall be allowed to dry before Rolling. The Rolling shall begin at the edges overlapping half the width of the Roller each time and progress to the center of the Road or towards the Building as applicable. Rolling will also be required on Rock Fills. No Compaction shall be carried out in rainy weather.

3.4.2 At all times, Unfinished Construction shall have adequate Drainage. Upon completion of the Road's Surface Course, Adjacent Shoulders shall be given a final shaping, true alignment, and grade.

3.4.3 The Density to which Fill Materials shall be compacted shall be as per relevant IS and as per direction of Purchaser. All Compacted Sand Filling shall be confined as far as practicable. Backfilled Earth shall be compacted to minimum 95 % of the Standard Proctor's Density at OMC. The Sub Grade for the Roads and Embankment Filling shall be compacted to minimum 95 % of the Standard Proctor's Density at OMC. Cohesion less Material Sub Grade shall be compacted to 70 % relative density (Minimum).

3.5 **REQUIREMENT FOR FILL MATERIAL UNDER FOUNDATION:**

The Thickness of Fill Material under the Foundations shall be such that the maximum pressure from the Footing, transferred through the Fill Material and distributed into the Original Undisturbed Soil, will not exceed the Allowable Soil Bearing Pressure of the Original Undisturbed Soil. For Expansive Soils, the Fill Materials and other Protections etc to be used under the Foundation is to be got approved by the Purchaser. For filling, no extra payment shall be made.

4.0 ANTIWEED TREATMENT AND SITE SURFACING:

4.1 **SCOPE OF WORK:**

The Bidder shall furnish all Labour, Equipment and Materials required for complete performance of the Work in accordance with the Drawings, Specification, and direction of the Purchaser.

Stone Spreading along with Cement Concrete Layer shall be done in the Areas of the Switchyard under Scope of Work including Future Bays as per Section – 1 (Project). The Stone spreading along with Cement Concrete Layer in Future Areas within the Fenced Area shall also be provided in case Step Potential without Stone Layer is not well within Safe Limits.

After due compaction of the surface of the entire switchyard area shall be provided with plain cement concrete of 75 mm thickness after proper compaction, and antiweed treatment having cement concrete ratio 1:5:10. Care shall be taken for proper gradient for easy discharge of storm water.

Water shall be sprinkled in such a manner that bulking does not take place. The 20 mm. nominal size (for both layers) shall pass 100% through IS sieve designation 37.5 mm and nothing through 16.0 mm. IS sieve

4.2 GENERAL REQUIREMENT:

The Material required for Site Surfacing / Gravel Filling shall be free of all type of Organic Materials and shall be of standard approved quality and as approved by the Purchaser.

4.2.1 After all the Structures / Equipment are erected, Anti - Weed Treatment shall be applied in the Switchyard where ever Stone Spreading along with Cement Concrete is to be done and the area shall be thoroughly de - weeded including removal of roots. The recommendation of Local Agriculture or Horticulture Department may be sought wherever feasible while choosing the type of chemical to be used. The Anti - Weed Chemical shall be procured from Reputed Manufacturers. The Doses and Application of Chemical shall be strictly done as per Manufacturer's recommendation. Nevertheless, the effectiveness of the Chemical shall be demonstrated by the Bidder in a Test Area of 10.0 meters x 10 meters (approximately) and shall be sprinkled with water at least once in the afternoon every day after forty - eight hours of application of Chemical. The Treated Area shall be monitored over a period of two to three weeks for any growth of weeds by the Engineer - in - Charge. The final approval shall be given by Engineer - in - Charge based on the results.

4.2.2 The Bidder shall furnish and install the Site Surfacing to the lines and grades in accordance with the requirements and direction of the Purchaser. The Soil of the entire Fenced and Earth Mat Area of Switchyard shall be subjected to Sterilization / Anti - Weed Treatment before placing the Site Surfacing / Gravel Fill Material of strictly as per instruction / requirement of the Manufacturer of the Chemical required for Anti - Weed Treatment. After all the Structures and Equipment have been Erected and accepted and Anti - Weed Treatment as specified is complete, the Site shall be maintained to the lines and graded indicated in the Drawing and rolled / compacted by using 3 Ton Roller with suitable Water Sprinkling to form a smooth and compact surface condition which shall be matching with Finished Ground Level of the Switchyard Area.

4.2.3 Engineer - in - Charge shall decide final Formation Level to ensure that the Site appears uniform devoid of undulations. The Final Formation Level shall however be very close to the Formation Level indicated in the Approved Drawing.

4.2.4 After the Soil Anti - Weed Treatment Material is applied and Surface prepared / compacted to the required Slope / Grade, a Base Layer of Uncrushed / Crushed Broken Stone / Pebbles (Gravel) of 20 mm nominal size shall be spread and rolled / compacted by using ½ Ton Roller (30" width and 24" diameter) with 4 to 5 passes and Water Sprinkling to form a minimum **50 mm** layer on the designed Finished Formation Level of the entire Fenced and Earth Mat Area of Switchyard Another Layer of minimum 50 mm, uniform Uncrushed / Crushed Broken Stone / Pebbles (Gravel) of 20 mm, nominal size or as specified, shall be spread over the Base Layer / Course. This Second Layer / Course shall then be compacted by Light Roller using

- ½ Ton Steel Roller (width 30” x diameter 24”) and 4 to 5 passes or any other means With water Sprinkling to form a minimum 50 mm Layer over the Base Layer / Course.
- 4.2.5 As a Final Surface Course Minimum 50 mm, uniform layer of Uncrushed / Crushed Broken Stone / Pebbles (Gravel) of 20 mm, nominal size or as specified shall be spread over the Second Layer / Course. This Final Surface Course shall be applied in all Areas exclusive of Roadways and shall extend beyond the Fenced Area as indicated in the Drawing. This Surface Course shall then be compacted by Light Roller using ½ Ton Steel Roller (width 30” x diameter 24”) and 4 to 5 passes or any other means with Water Sprinkling as directed by the Engineer - in - Charge. Water shall be sprinkled in such a manner that bulking does not take place. 20 mm nominal size (for all layers) shall conform to Table 2 of IS: 383.
- 4.2.6 In Areas that are considered by the Purchaser / Engineer - in - Charge to be too congested with Foundations and Structures for proper rolling of the Site Surfacing Material by normal Rolling Equipment, the Material shall be compacted by hand, if necessary. Due care shall be exercised so as not to damage any Foundation, Structures or Equipment during Rolling Compaction.
- 4.2.7 The sub grade shall be in moist condition at the time the Cement Concrete is placed. If necessary, it should be saturated with water for not less than 6 hours but not exceeding 20 hours before placing of Cement Concrete. If it becomes dry prior to the actual placing of Cement Concrete, it shall be sprinkled with water, and it shall be ensured that no pools of water or soft patches are formed on the surface.
- 4.2.8 Over the prepared sub grade, 75 mm thick base layer of Cement Concrete in 1:5:10 (1 Cement : 5 Fine / Coarse Sand : 10 Burnt Brick Aggregate) shall be provided in the Area excluding Roads, Drains, Cable Trenches as per detailed engineering drawing. For easy drainage of water, the Slope of 1:1,000 is to be provided from the Ridge to the nearest drain. The Ridge shall be suitably located at the center of the area between the nearest drains. The above slope shall be provided at the top of base layer of Cement Concrete in 1:5:10. A layer of Cement Slurry of Mix 1:6 (1 Cement: 6 Fine Sand) shall be laid uniformly over Cement Concrete Layer. The Cement consumption for Cement Slurry shall not be less than 150 kg per 100 sq. m.
- 4.3 **CHEMICAL TO BE USED FOR SOIL ANTI WEED TREATMENT:**
- The Details of Quantities and Method of Application of Chemicals used for Soil Anti - Weed Treatment shall be as per Manufacturer’s Recommendations. Bidders are required to submit the details of Chemicals proposed to be used and recommendations of Manufacturer with required Guarantee along with their Bids for necessary approval of Purchaser. Approval of Purchaser by no means shall relieve the Bidder from their contractual obligations as stipulated in General and Special Conditions of Contract. The Recommendation of Local Agriculture / Horticulture Department shall also be considered while choosing the type of Chemical to be used with respect to

Variety of weeds present in the Area. Bidders are required to submit the Anti - Weed Manufactures Name for approval of Owner.

5.0 SITE DRAINAGE:

- 5.1 Adequate Site Drainage System shall be provided by the Bidder. The Bidder shall obtain Rain Fall Data and design the Storm Water Drainage System, (Culverts, Ditches, Drains etc) to accommodate the most intense Rain Fall that is likely to occur over the Catchments Area in one hour period on an average of once per ten years. The Surface of the Site shall be sloped to prevent the pounding of water.
- 5.2 The Maximum Velocity for Pipe Drains and Open Drains shall be limited to 2.40 m / sec. and 1.80 m / sec. respectively. However, minimum Non Silting Velocity of 0.60 m / sec. shall be ensured. Longitudinal Bed Slope not more than 1 in 500 shall be provided.
- 5.3 For design of RCC Pipes for Drains and Culverts, relevant Indian Standard shall be followed.
- 5.4 The Bidder shall ensure that Water Drains are away from the Site Area and shall prevent damage to adjacent property by this Water. Adequate Protection shall be given to Site Surface, Roads, Ditches, and Culverts etc to prevent erosion of Material by Water.
- 5.5 The Drainage System shall be adequate without the use of Cable / Pipe Trenches. Pipe Drains shall be provided in Areas of Switchyard where movement of Crane will be necessary in operating phase of the Sub Station.
- 5.6 For Pipe Drains, Concrete Pipe of Class NP2 shall be used. However, for Road Crossings etc higher strength Pipe of Class NP3 shall be provided. For Rail Crossings, RCC Pipes conforming to Railway Loading Standards of 70R Loading or at least NP4 Class shall be provided. Man Holes shall be provided at every 30.0 meters interval, at connection points and at every change of alignment / bend.
- 5.7 Open Surface Drains shall be provided with Bricks of Class designation 105 in Cement Mortar 1: 4 including 100 mm thick Bed Concrete of Grade 1: 1½: 3 and 12 mm Thick Cement Plaster 1: 4 with a floating coat of Neat Cement inside the Drains, its top and exposed sides as per design and drawing approved by the Purchaser. For Expansive Soils, the Guidelines of IS: 9451 shall be followed.
- 5.8 In General, all Plant Effluent Drainage shall be through buried Concrete Pipes and all Storm Water Drainage shall be through Open Drains / Pipe Drains. Open Storm Water Drains shall be provided on both sides of the Roads and shall be designed to drain the Road Surface as well as all the free and covered Areas etc.
- 5.9 Pipe Drains shall be connected through Man Holes at an interval of maximum 30.0 meters. Plant Effluents shall be suitably treated by the Bidder to meet all the prevalent statutory requirements and Local Pollution Control Norms and Treated

Effluents shall be conveyed to the Storm Water Drainage System at a suitable location for its final disposal.

- 5.10 Invert Level of the Drainage System at outfall point shall be decided in such a way that the Water can easily be discharged above the High Flood Level (HFL) Outside Sub Station Boundary Wall at suitable Location and approved by Purchaser. Pumps for drainage of Water (if required) shall be provided by Bidder.
- 5.11 All Internal Site Drainage System, including the Final Connection / Disposal to Purchaser acceptance points shall be part of Bidder's Scope, including all required Civil Work, Mechanical and Electrical Systems.
- 5.12 The Pre - Cast Man Holes shall be preferred against cast in - situ type. The Drainage Scheme may employ either Open Drain System or Underground Pipe System or a combination of both. A Man Hole shall be provided at every turn, corner in case of Underground Type in addition to the normal requirements.
- 5.13 2 number Portable Pumps of 5 HP Capacity shall be provided by the Bidder to pump out the Water from Sump to the Open Channel; Automatic Float Valve Type Pump shall be provided and installed by Bidder.
- 5.14 The Bidder shall locate the Outfall Point Outside the Sub Station Vicinity so that it may not cause any damage to Sub Station and the Sub Station Storm Drainage must be connected to this point.
- 5.15 In the Switchyard, maximum spacing between two Drains shall not be more than 75 meters. It will be ensured that no Area is left un - drained.
- 5.16 The Drainage Scheme and Associated Drawings shall be got approved from the Purchaser before commencement of Construction.
- 5.17 In addition to Drainage of Rainwater, the Bidder shall arrange for Rainwater Harvesting.
- 5.18 Rainwater Harvesting shall be done by providing two numbers Recharge Structures with bore wells. The Recharge Structures shall be suitably located within the Substation. Branch Drains from the main drain carrying rainwater from entire Switchyard shall be connected to the Recharge Structures. Only One (1) Nos. Recharge Well is envisaged for all the Switchyard Buildings.
- 5.19 Bore well shall be done by suitable soil as per soil strata for control room building, GIS and firefighting.

A sewage system shall be provided for all utility buildings including the Control room building and other auxiliary buildings.

The Contractor shall construct suitable septic tank and soak pit for the discharge of effluents.

Sewers shall be designed for a minimum self-cleansing velocity of 0.6m/sec and the maximum velocity shall not exceed 2.4m/sec.

The sewage system shall consist of all necessary piping, pumps, if required, fittings, manholes, clean - outs, piping connections and all other materials required for safe and efficient sewage collection. Sewer pipes and fittings shall conform to the relevant Indian Standards.

Cast iron pipes shall be used below ground level for sewage disposal.

Manholes shall be provided at every 20 meters along the length, at connection points and at every change of alignment, gradient or diameter of a sewer pipe line.

6.0 ROADS AND CULVERTS:

- 6.1 Within Employer's Property Line and Sub Station Area, Roads provided for access to Equipment and Building is in the Scope of Bidder. Layout of the Roads shall be based on General Detail and Arrangement Drawings for the Sub Station. Road to the Transformer shall be as short and straight as possible. In case of Switchyard Roads, the Shoulder would be compacted earth 1000 mm wide on the sides of both types of Road. The Approach road connecting nearby public road is also under Bidder Scope which is of 7 meters bitumen grading. The Switchyard road upto transformer it is of 7 meters from gate, it shall be RCC and all the peripheral roads inside the switchyard shall be 3.75 meters RCC roads.
- 6.3 The Road shall have 100 mm thick **RCC M: 25** (with Reinforcement of 8 mm diameter 200C/C both ways) on the Top. Below it 100 mm thick PCC (1:2:4) shall be provided. 300 mm thick, Water Bound Macadam (WBM) in three equal layers of 100 mm each at the bottom.
- 6.4 PCC and WBM shall extend up to the Shoulder Width on both sides of the Road outside Switchyard Area. In case of Road within the Switchyard, PCC and WBM shall be placed only up to the width of the Road. Polythene Sheet of 125 microns shall be placed between the RCC and PCC Slab. Expansion Joint (12 mm thick) shall be provided at every 8.0 meters. In addition, in case of 5.5 meters wide Road, Expansion Joint shall also be provided longitudinally at the centre. 100 mm diameter RCC Hume Pipe (NP - 3) shall be provided at every 100 meters interval across the length of the Road for Cable Crossing.
- 6.5 The Concrete shall be laid and finished with Screed Board, Vibration, Vacuum Dewatering Process, and finishing by Floating Brooming with Wire Brush etc.
- 6.6 Road Construction shall be as per IRC Standards.
- 6.7 Adequate provision shall be made for Road Drainage.
- 6.8 All the Culverts and its allied Structures (required for Road / Rail, Drain, Trench Crossings etc) shall be designed for Class 70 R Loading as per IRC Standard / IS Code and should be checked for Power Transformer Loading.
- 6.9 All Roads shall be designed for Class 'C' of Traffic as per IRC 37 - 1984 'Guide Lines for the Design of Flexible Pavements' and as per IRC 58 for rigid pavements. California Bearing Ratio (C. B. R) Method will be followed for the Design Roads. A detailed C. B. R. Test shall be carried out as per the procedure outlaid in IS: 2720 (Part 16).
- 6.10 The surface of the hard standing shall be laid with falls to the drainage system. Care shall be taken during the construction that no materials enter the drainage system.

6.9 At the junction of the hard standing and roads due to different thickness of Foundations precautions shall be taken to ensure that sub-surface drainage from the hard standing does not have a detrimental effect upon the road foundations.

7.0 POWER TRANSFORMER FOUNDATION, RAIL TRACK / ROAD CUM RAIL TRACK:

7.1 The Bidder shall provide a Permanent Transformer Foundation, Foundation shall be suitable for Impact Load. Foundation shall cover RCC, Rail etc required for placing Transformer in position. The Transformer Track System shall be part of **Road Cum Rail Track**, which shall be suitable to permit the movement of any failed Unit of fully assembled Transformer (including OLTC, Bushings, etc) with Integral Radiators and Oil, without the de-energisation of any other Equipment in the Sub Station. This System shall enable the removal of any Failed Unit from its Foundation to a Repair Area and the installation of the Spare Unit. The System, preferably, shall not interfere with the normal Internal Road and Trench System. If Trench / Drain Crossings are required then suitable RCC Culverts shall be provided in accordance with IRC Code / Relevant IS capable of 70R Loading.

7.2 Rail Track between Road Cum Rail Track and Transformer Platform shall rest on **RCC M: 25** and beyond i.e. Road Cum Rail Track, Rail shall rest on Stone Ballast and Pre Stressed Concrete Sleepers / Beams or on RCC M: 25 suitable for intended purpose as approved by RDSO. The Space of Road Cum Rail Track shall suitably be filled with Local Sand and 75 mm thick P. C. C. of **Grade 1: 3:6** placed over Sand Filling. The top of P. C. C. or RCC of Road Cum Rail Track as the case may be, shall match with the **Plinth Foundation of Transformer** and shall be suitable to carry 70R Loading.

7.3 The Rail shall be second quality Flat Bottom as per Indian Railway Specification T18 - 69 and its subsequent revision. Rail for Road Cum Rail Track is covered in the Scope of Supply by the Bidder. In Rail Track, Rail shall be measured and paid separately, the Bidder is required quote Unit Rate of Rail accordingly.

The top of PCC shall be up to the formation level. In case of road cum rail track, 75mm thick PCC of grade 1:1.5:3 shall be placed up to the road level. Suitable drainage system between the tracks shall be provided.

The rails shall be first quality 52 kg/m medium manganese steel as per Indian Railway specification T-12-64 and its subsequent revision, joined together by fish plates as per Indian Railway specification T-1/57, and 27 mm diameter fish bolts.

A pylon support system shall be provided for supporting the firefighting system by the Contractor.

For design of foundation for transformer refer the weightage of the transformer indicated in the BPS (civil works)

7.4 **OIL RECOVERY SYSTEM:**

The Oil Recovery System shall be provided for all Transformers (containing Insulating Oil or any Flammable or Polluting Liquid) in order to avoid spread of Fire by the Oil, and for environmental protection.

7.4.1 **DESCRIPTION:**

Each Power Transformer including Oil Conservator Tank and Cooler Banks etc., shall be placed in a self - sufficient Oil Soak Pit surrounded by Retaining Walls (Pit Walls). The Clear Distance of the Retaining Wall of the Pit from the Transformer shall be 20% of the Transformer height or 0.80 meter whichever is more. The Oil Collection Pit thus formed shall have a Void Volume equal to 120 % Volume of Total Oil in the Transformer. The Minimum Height of the retaining Walls shall be 20 cm above the Finished Level of the Ground to avoid outside water pouring inside the Pit.

7.4.1.2 The Grating shall be made of MS Flat of size 40 mm x 5 mm placed at 30 mm center to center and 25 mm x 5 mm MS Flat at an spacing of 150 mm at right angle to each other. Maximum length of Grating shall be 2,000 mm and width shall not be less than 500 mm. The MS Grating supported on ISMB 150 mm shall be placed at the Formation Level and will be covered with 100 mm thick layer of Broken / Crushed / Non Crushed Stone of 40 mm nominal size, which acts as an extinguisher for Flaming Oil.

7.4.1.3 Each Oil Collection Pit shall be drained towards a Sump Pit within the Collection Pit whose role is to drain Water and Oil due to leakage within the Collection Pit so that Collection Pit remains dry and clean.

7.5.1 **MATERIALS:**

7.5.1.1 The Retaining Walls which make up the Oil Soak Pit shall be made of Fire Resistant Material such as Reinforced Cement Concrete; Fire Brick etc and shall be impervious to Oil.

7.5.1.2 The Minimum Height of the Retaining Walls shall be 20 cm above the Finished Level of the Ground to avoid outside Water pouring inside.

7.5.1.3 The Bottom of the Pit shall have a uniform slope towards the Sump Pit.

7.5.2 **DRAINAGE:**

A Device showing level of Sump Pit shall be fitted along with the Automatic Pumping System that shall have sufficient capacity (5 HP) to evacuate the Fire Fighting and Rain Water from the Sump Pit. The Bidder may propose other better scheme for approval of the Purchaser.

7.5.3

BOUNDARY WALL/COMPOUND WALL:

The scope includes the design, engineering and construction of the boundary wall all along the property line of the OPTCL on each sub-station Construction of Boundary wall: The boundary wall shall be constructed to a height of 2 mtrs above finished ground level of the substation area with 10" wide brick masonry work with RCC ground tie beam to be rested on the RCC pillars (pillar to pillar distance @ 3mtrs) as detailed below. Galvanized barbed wire (12 SWG) of 3-rows each limb of Y shaped frame (Total 6 nos) fencing shall be provided on top of the boundary wall to a height of 0.5 mtr as detailed below.

The boundary wall shall be designed based on the soil investigation data.

Salient points to be considered at the time of design:

- (1) RCC pillars to be considered. RCC pillar to pillar distance shall be maximum 3mtrs along the boundary line. The height of the RCC pillars shall be 2 mtrs above finished ground level of the substation area and below the virgin soil a minimum of 750 mm depth Size of the RCC Pillar: 250mmX250mm. Provision of MS rod: (a) Vertical 12 mm Ø: 6 Nos. (b) Stirrup: 8 mm Ø, 200 mm c/c. There shall be provision of RCC Raft at the bottom of the RCC pillar. Size of the Raft shall be 500 mmX500mmX200mm. Provision of MS rod: (a) Both way top & Bottom 12 mm Ø in two layers: 3 Nos. each (total 12 nos)
- (2) RCC tie beam: continuous RCC tie beam to be rested on the RCC pillars below the finished ground level all along the boundary line Provision of MS rod: (a) Horizontal 12 mm Ø: 6 Nos. (b) Stirrup: 8 mm Ø at 200 mm C to C.
- (3) Brick works: 1st Class Brick of size 250 mm all along the boundary wall to be provided Cement sand mortar of ratio (1:5) to be provided for brick masonry works. The height of the brick wall shall be minimum 2 mtrs height from the top of the tie beam provided at the finished ground level. A 50mm height of finished concrete (ratio 1:2:4) shall be provided on the top of the boundary wall. 250mm Brick masonry work of 500mm depth below the tie beam also to be considered where ever required.

BRICK:

The brick shall be machine moulded and made from suitable fly ash, cement, lime, gypsum, etc. They shall be free from cracks and nodules of free lime. They shall have smooth rectangular faces with sharp corners and shall be of uniform colour. The bricks shall be moulded with the frog of 100mm x 40 mm and 10mm to 20mm deep on one of its flat sides. The bricks shall not break when thrown on the ground from a height of 600mm The size of the modular bricks shall be 190 x 90 x 90 mm The size of the conventional bricks shall be 250 x 125 x 75mm.

Only bricks of one standard size shall be used on one work. The following tolerance

shall be permitted in the conventional size adopted in a particular work. Length +3.0mm, Width + 1.50mm, Height +1.50mm.

The crushing strength of the brick shall not be less than 75.0 Kg / Sq cm. The average water absorption shall be within 13-15% by weight. Similarly, the porosity of the fly ash bricks shall be within 12-20%. Necessary test for crushing strength

And water absorption shall be carried out as per IS 3495 : (Part I to Part IV) 1976.

(4) Cement plastering works: Cement sand mortars of ratio (1:5) to be provided both the sides of the boundary wall.

(5) Galvanized barbed wire fencing shall be provided on top of the boundary wall to a height of 0.5 mtr. G.I Barbed wires (12 SWG) of 3-rows each limb of Y shaped frame (Total 6 nos) shall be provided. A minimum length of 300mm (bottom portion of the Y shaped frame) shall be grouted and a clear height of 500 mm from the finished portion of the top of the wall shall be maintained for the Y shaped frame with GI barbed wires. The —Y| post shall be galvanized one. The Y shape GI frame shall be grouted on the top of the concrete pillar inside a pocket of size 100 Sq mm X 300 mm deep with Cement concrete. The size of the GI angle shall be 65X65X6 mm. The height of the Y shaped frame shall be clear height of 500 mm from the finished portion of the top.

(6) Colouring: After the cement wash on the entire boundary wall two coats of weather coats paint to be applied.

(7) In case the boundary wall to be designed considering pile foundation, the minimum dia of the pile shall be 250mm of required length as per the design based on soil investigation. Rest of the boundary wall shall be in line with the above description from Sl. No-2 to Sl. No.-6.

(8) Boundary shall have one main gate as per stipulation elsewhere in the spec. The gate shall be supported by gate pillars of RCC. A separate wicket gate shall be provided adjacent to the main gate.

8.0 FIRE PROTECTION WALLS:

8.1 GENERAL:

Fire Protection Walls shall be provided in accordance with Tariff Advisory Committee (TAC) recommendations.

8.2 APPLICATION CRITERIA:

A Fire Wall shall be erected between the Transformers if the free distance between the various pieces of Equipment is less than 10.0 meters to protect each one from the effects of Fire on another. The GIS building wall adjacent to the Transformers shall be made of RCC wall (Fire Protection).

Also, if the free distance between the Transformer and Auxiliary Services Transformers is less, the Fire Wall shall be erected.

8.3 FIRE RESISTANCE:

- 8.3.1 The Fire Wall shall be capable to resist the Fire for at least 4 hours. The Partitions, which are made to reduce the Noise Level of the Transformer, shall have the same Fire Resistance. The Walls of the Building, which are used as Fire Walls, shall also have a minimum Fire Resistance of 4 hours.
- 8.3.2 The Fire Wall shall be designed in order to protect against the effect of radiant heat and flying debris from an adjacent Fire.

8.4 MECHANICAL RESISTANCE:

- 8.4.1 The Fire Wall shall have the Mechanical Resistance to withstand Local Atmosphere Conditions. If this Wall shall serve as a support for Equipment such as Insulators etc, its Mechanical Rigidity must be increased.
- 8.4.2 Connecting the Walls by Steel or other Structures, which may produce a reversing torque if over - heated, shall be avoided.

8.5 DIMENSIONS:

- 8.5.1 The Fire Wall shall extend at least 2.0 meters on each side of the Transformers and shall be at least 1.0 meter above the Conservator Tank or Safety Vent. A minimum 2.0 meters clearance shall be provided between the Equipments e.g. Transformers / Reactors and Firewalls. In case of space constraints, these dimensions can be reduced as per the approval of Owner
- 8.5.2 The Building Walls, which act as Fire Walls, shall extend at least 1.0 meter above the Roof in order to protect it.
- 8.5.3 The Firewall will be made of Reinforced Concrete M: 25.

8.6 MATERIALS:

The Fire Wall may be made of Reinforced Concrete M: **25 Grade**, Firebrick, Concrete Blocks or Corrugated Iron on a Steel Structure as per the System requirements. Materials used must conform to the Standards of the National Fire Prevention Association and TAC Norms.

9.0 CABLE AND PIPE TRENCHES:

- 9.1 The Cable Trenches and Pre - Cast Removable RCC Cover (with Lifting Arrangement) shall be constructed using RCC of M: 25 Grade.
- 9.2 The Cable Trench Walls shall be designed for the following Loads: -
- a) Dead Load of 155 kg / m Length of Cable support + 75 kg on one Tier at the outer edge of the tier.
 - b) Earth Pressure + Uniform Surcharge Pressure of 2 T / sq. m.
- 9.3 Cable Trench Covers shall be designed for self - Weight of Top Slab + Concentrated Load of 200 kg at Centre of Span on each Panel.

- 9.4 Cable Trench Crossing the Road / Rail shall be designed for Class 70R Loading of IRC and should be checked for Transformer Loading.
- 9.5 Trenches shall be designed with Drainage arrangement. Necessary Sumps shall be constructed and Sump Pumps shall be supplied. Cable Trenches shall not be used as Storm Water Drains.
- 9.6 The Top of Trenches shall be kept at least 200 mm above the Finished Ground Level. The Top of Cable Trench shall be such that the Surface Water does not enter the Trench.
- 9.7 All Metal Parts inside the Trench shall be connected to the Earthing System.
- 9.8 Cables from Trench to Equipment shall run in Hard Conduit Pipes.
- 9.9 Trench Wall shall not foul with the Foundation. Suitable Clear Gap shall be provided.
- 9.10 A Clear (Vertical) Space of at least 250 mm shall be available for each tier in Cable Trench. From Trench Bed to Lowest Tier, a minimum clearance of 200 mm shall be available.
- 9.11 The Trench Bed shall have a slope of 1: 500 along the run and 1: 250 perpendiculars to the run.
- 9.12 All the Construction Joints of Cable Trenches i.e. between Base Slab and the Junction of Vertical Wall to Base Slab as well as from Vertical Wall to Wall and all the Expansion Joints shall be provided with approved quality PVC Water stops of approximately 230 x 5 mm size for those Sections where the Ground Water Table is expected to rise above the Junction of Base Slab and Vertical Wall of Cable Trenches.
- 9.13 Cable Trenches shall be blocked at the end if required with Brick Masonry in Cement Sand Mortar 1: 4 and Plaster with 12 mm thick 1: 4 Cement Sand Mortar. Cable tray supports(all galvanized structures) shall be designed and constructed to be a single complete fabrication or assembly such that every layer of the horizontal cable tray supports are fixed, either bolted or welded, to a vertical steel support that is embedded in the concrete wall of the cable trough. It shall not be permitted to embed a horizontal support beam directly into the wall of the trough in order to use the concrete wall as a means of load bearing.
- 9.13 Concrete troughs shall be provided with concrete covers of suitable load bearing strength. Where the cable troughs are run across or within 3 m of substation roads, the trough covers shall be capable of bearing an accidental wheel load of 20 kN.
- 9.14 All the cable trenches shall be RCC type with mixing ratio 1:1.5:3. The size of MS rod to be used for the same area of 8mm tor and 6mm. All the vertical rod shall be 8 mm continuous and the wall and raft shall contain 2 nos. 8 mm rods at two layers and spacing shall be 150mm. The horizontal binders shall be of 6mm rod two nos in two layers and to be placed at 200mm centre to centre for both on the wall and raft portion of the trench. The mentioned rod placements are for section 1-1, 2-2, and 3-3. For section 4-4 instead of two 8mm and 6mm rods single rods can be used.

9.15 A frame of hot dip galvanized angles of size 50X50X6 mm having provision of MS chairs on the grouting side on to the walls of the trench preferably at two locations(at top and bottom) of the frame (these chairs have to be welded with the rods of the wall for better rigidity). For section 1-1 there shall be of 4 tier mechanism for fixing of cable tray having width of the angle 450mm (3 nos) and the top angle shall be of 300 mm, and the quantity of such type of frame shall be 2 (for both way). For section 2-2 only one frame of the above mentioned one shall be used. For section 3-3 there shall be one frame but with three tier mechanism for fixing the cable trays. For section 4-4 two tier system of angle width shall be 200 mm width at the bottom and 100 mm width at the top. Fixing of the cable tray support stand (Frame) is to be fixed at a distance of 1 mtrs from one frame to the other.

9.16 The thickness of the RCC wall of the trench shall be 100mm and thickness of the raft shall be 75mm. All the frames for fixing of cable trays shall be of hot dip galvanized. A running earth strip has to run all through the cable trench for proper earthing of the cable trays and stand (frame).The size of the earth strip is of 50X6mm G.I flats. Welding the GI flats to the frame to be carried out. Earthing strips to be welded with the running earth mat at 10mtrs interval The bidder also to supply and fix G.I perforated cable trays (of thickness 2mm) of appropriate size before laying of cables on the cable tray stand.

The other dimensions of the cable trench are as below.

S. No	Section	No of tiers in each frame/ and no of such frame	Gap between the two angles in mm	Inside Clearance in mm		Outside clearance in mm		Concrete thickness in mm	
				Top to Bottom m	Wall to wall	Top to Bottom m	Raft width	Wall	Raft
1	1-1	Four tiers/ Two (both way)	200	1275	1400	1350	1750	100	75
2	2-2	Four tiers/single (one way)	200	1275	900	1350	1450	100	75
3	3-3	Three/ single	200	1075	900	1150	1450	100	75

The covers of the slab are also of RCC with ratio mixing 1:1.5:3.The thickness of the slab shall be 75mm for section 1-1(MS Rods to be used 10mm&8mm), section 2-2, 3-3 shall

be 60mm (MS Rod to be used 8mm) and section 4-4 shall be 50mm (MS Rods to be used 8mm & 6mm). The MS rods to be used shall be placed at 100 mm centre to centre both way and properly binned. The cover slab shall have provision of lifting hooks at two points for easy lifting of the slabs. Slabs having lifting hooks shall be placed at every 10th slabs. The lengths of the cable trench cover slabs are as below.

Section :	Length of the slab :	Thickness of the slab:
1-1	1600mm	75mm
2-2	1100mm	60mm
3-3	1100mm	60mm
4-4	400mm	50mm

The covers for the cable trench inside the control room shall be provided with MS chequered plate with MS angle stiffeners at the bottom for proper mechanical strength.

10.0 FOUNDATION / RCC CONSTRUCTION:

10.1 GENERAL:

10.1.1 Work covered under this Clause of the Specification comprises the Design, Construction of Foundations and other RCC Constructions for GIS Building Switchyard Structures, Equipment Supports, Trenches, Drains, Jacking Pad, Pulling Block, Control Cubicles, Bus Supports, Tanks or for any other Equipment or Service and any other Foundation required to complete the Work. This Clause is also applicable to the other RCC Constructions.

10.1.2 Concrete shall conform to the requirements mentioned in IS: 456 and all the Tests shall be conducted as per relevant Indian Standard Codes as mentioned in Standard Field Quality Plan appended with the Specification. However, a minimum grade of M: 25 Concrete shall be used for all Structural / Load Bearing Members.

10.1.3 If the Site is sloppy, the Foundation Height will be adjusted to maintain the exact level of the Top of Structures to compensate such Slopes.

10.1.4 The Switchyard Foundations Plinths and Building Plinths shall be minimum 300 mm and 500 mm above Finished Ground Level respectively.

10.1.5 Minimum 75 mm thick Lean Concrete 1: 3: 6 shall be provided below all Underground Structures, Foundations, and Trenches etc to provide a Base for Construction.

10.1.6 Concrete shall be carefully cured and special importance shall be given during the placing of Concrete and removal of Shuttering.

10.1.7 The Design and Detailing of Foundations shall be done based on the approved Soil Data and Sub Soil Conditions as well as for all possible Critical Loads and the combinations thereof. The Spread Footings Foundation or Pile Foundation as may be required based on Soil / Sub Soil Conditions and Superimposed Loads shall be provided.

10.1.8 If Pile Foundations are adopted, the same shall be cast - in - situ driven / bored of pre

- cast or under reamed type as per relevant IS: 2911. Only RCC Piles shall be provided. Suitability of the adopted Pile Foundations shall be justified by way of Full Design Calculations. Detailed Design Calculations shall be submitted by the Bidder showing complete Details, Routine Load Test of Piles / Pile Groups proposed to be used. Necessary Initial Load Test and Routine Load Test shall also be carried out by the Bidder at his Cost to establish the Piles Design Capacity. Only after the design capacity of Piles has been established, the Bidder shall take up the Job of Piling. All the Work (Design and Testing) shall be planned in such a way that these shall not cause any delay in Project Completion.

10.2 **DESIGN:**

- 10.2.1 All Foundations shall be of Reinforced Cement Concrete The Design and Construction of RCC Structures shall be carried out as per IS: 456 and minimum Grade of Concrete M: 25 for R.C.C. Works shall be used.
- 10.2.2 Limit State Method of Design shall be adopted unless specified otherwise in the Specification.
- 10.2.3 For Design and Construction of Steel Concrete Composite Beam IS: 11384 shall be followed.
- 10.2.4 For detailing of Reinforcement IS: 2502 and SP: 34 shall be followed. High Yield Strength Deformed Bars of Grade Fe500 conforming to IS: 1786-1985 shall be used as reinforcement steel. However, in specific areas, Mild Steel (Grade - I) conforming to IS: 432 can also be used. Two Layers of reinforcement (on inner and outer face) shall be provided for Wall and Slab Sections having thickness of 150 mm and above. Clear Cover to reinforcement shall be as per IS: 456 (Latest).
- 10.2.5 RCC Water Retaining Structures like Storage Tanks, Cooling Water Basin etc shall be designed as Un - Cracked Section in accordance with IS: 3370 (Part I to IV) by Working Stress Method. However, Water Channels shall be designed as Cracked Section with Limited Steel Stresses as per IS: 3370 (Part I to IV) by Working Stress Method
- 10.2.6 The procedure used for the Design of the Foundations shall be for the most Critical Loading Combination of the Steel Structure and / or Equipment and / or Superstructure and other Conditions, which produces the maximum stresses in the Foundation or the Foundation Component and as per the relevant IS Codes of Foundation Design. The Bidder shall submit detailed Design Calculations showing complete details of Piles / Pile Groups proposed to be used.
- 10.2.7 All Foundations shall rest below Natural Surface Level and the minimum depth of Foundation below the Natural Surface Level shall be at least 500 mm.
- 10.2.8 Designs shall consider any Sub Soil Water Pressure that may be encountered, following relevant Standard strictly.
- 10.2.9 Necessary Protection to the Foundation Work, if required shall be provided to take

- care of any special requirements for aggressive Alkaline Soil, Black Cotton Soil, or any other Type of Soil, which is detrimental / harmful to the Concrete Foundations.
- 10.2.10 RCC Columns shall be provided with Rigid Connection at the Base.
- 10.2.11 All Sub Structures shall be checked for Bearing pressure, Sliding, Overturning and uplift Stability during both Construction and Operating Conditions for various combinations of Loads. Factors of Safety for these cases shall be taken as mentioned in relevant IS Codes or as stipulated elsewhere in the Specifications. For checking against Overturning, Weight of Soil Vertically above Footing shall be taken and inverted Frustum of Pyramid of Earth on the Foundation should not be considered.
- 10.2.12 Earth Pressure for all Underground Structures shall be calculated using coefficient of Earth Pressure at Rest, coefficient of Active or Passive Earth Pressure (whichever is applicable). However, for the design of Sub Structures of any underground Enclosures, Earth Pressure at rest shall be considered.
- 10.2.13 In addition to Earth Pressure and Ground Water Pressure etc, a Surcharge Load of 2 T / sq. m. shall also be considered for the design of all Underground Structures including Channels, Sumps, Tanks, Trenches, Substructure of any Underground Hollow Enclosures etc for the Vehicular Traffic in the vicinity of the Structure.
- 10.2.14 Following Conditions shall be considered for the design of Water Tank in Pumps House, Channels, Sumps, Trenches and other Underground Structures: -
- a) Full Water Pressure from inside and no Earth Pressure and Ground Water Pressure and Surcharge Pressure from outside (application only to Structures, which are liable to be filled up with Water or any other Liquid).
 - b) Full Earth Pressure, Surcharge Pressure and Ground Water Pressure from outside and no Water Pressure from inside.
 - c) Designs shall also be checked against buoyancy due to the Ground Water during construction and maintenance stages. Minimum Factor of Safety of 1.5 **against buoyancy** shall be ensured, ignoring the Superimposed Loadings.
- 10.2.15 Base Slab of the any Underground Enclosure shall also be designed for empty condition during construction and maintenance stages with Maximum Ground Water Table (GWT). Minimum Factor of Safety of 1.5 against buoyancy shall be ensured, ignoring the Superimposed Loadings.
- 10.2.16 Base Slab of any Underground Enclosure like Water Storage Tank shall also be designed for the condition of different combination of Pump Sumps being empty during maintenance stages with maximum GWT. Intermediate dividing piers of such Enclosures shall be designed considering Water in one Pump Sump only and the other Pumps Sump being empty for maintenance.
- 10.2.17 The Foundations shall be proportioned so that the Estimated Total and Differential
- Movements of the Foundations are less than the Movements that the Structure or

Equipment is designed to accommodate.

- 10.2.18 The Foundations of Transformer and Circuit Breaker shall be of Block Type Foundation. Minimum Reinforcement shall be governed by IS: 2974 and IS: 456.
- 10.2.19 The Tower and Equipment Foundations shall be checked for a partial Factor of Safety of 2.2 for Normal Condition and 1.65 for Short Circuit Condition.
- 10.2.20 The Bidder shall provide a RCC Rail cum Road System integrated with the Transformer Foundation to enable installation and the replacement of any failed Unit. The Transfer Track System shall be suitable to permit the movement of any failed Unit fully assembled (including OLTC, Bushings) with Oil. This System shall enable the removal of any failed Unit from its Foundation to the nearest Road. If Trench / Drain Crossings are required then suitable RCC Culverts shall be provided in accordance with I. R. C. Standard / relevant IS.

The Bidder shall provide a Pylon Support System for supporting the Fire Fighting System

Each Transformer including Oil Conservator Tank and Cooler Banks etc shall be placed in a self - sufficient pit surrounded by Retaining Walls (Pit Walls)The clear distance of the Retaining Wall of the Pit from the Transformer /Reactor shall be 20% of the Transformer height or 0.8 meter, whichever is more. The Oil Collection Pit thus formed shall have a void volume equal to 200 % volume of Total Oil in the Transformer. The minimum height of the Retaining Walls shall be 15 cm above the Finished Level of the ground to avoid outside water pouring inside the Pit. The bottom of the Pit shall have a uniform slope towards the Sump Pit. While designing the Oil Collection Pit, the movement of the Transformer must be taken into account.

The Grating shall be made of MS Flat of size 40 mm x 5 mm placed at 30 mm centre to centre and 25 mm x 5 mm MS Flat at an spacing of 150 mm at right angle to each other. Maximum length of Grating shall be 2,000 mm and width shall not be more than 500 mm. The Gratings, supported on ISMB 150 mm, shall be placed at the Formation Level and will be covered with 100 mm thick layer of Broken / Crushed / Non Crushed Stone having size 40 mm to 60 mm, which acts as an extinguisher for flaming Oil.

Each Oil Collection Pit shall be drained towards a Sump Pit of size 1,000 x 750 mm and 500 mm deep below the Floor Level within the Collection Pit whose role is to drain water and oil due to leakage within the Collection Pit so that Collection Pit remains dry.

10.2.21 **Machine Foundations**

All machine foundations shall be designed in accordance the provisions of the relevant parts of the latest revisions of IS 2974, IS 456 and IS 2911. The provisions of DIN 4024 (latest) shall also be followed.

All block foundations resting on soil or piles shall be designed using the elastic half

space theory.

The mass of the RCC block shall not be less than three times the mass of the machine. Dynamic analysis shall be carried out to calculate natural frequencies in all the modes including coupled modes, and to calculate vibration amplitudes.

Frequency and amplitude criteria as laid down by the relevant IS codes and/or machine manufacturers, shall be satisfied, Minimum reinforcement shall be governed by IS 2974 and IS 456, For the foundations supporting minor equipments weighing less than one tonne or if the mass of the rotating parts is less than one-hundredth of the mass of the foundation, no dynamic analysis is necessary. However, if such minor equipment to be supported on building structures, floors etc. suitable vibration isolation shall be provided by means of springs, neoprene pads etc. and such vibration isolation system shall be designed suitably.

10.2.22 OTHER FOUNDATIONS:

All Foundations shall be designed in accordance with the provisions of the relevant parts of latest revisions of Indian Standard IS: 2911 and IS: 456.

Type of Foundation System i.e. Isolated Footing or Raft or Piling shall be decided based on the Load Intensity and Soil Strata.

The Tower and Equipment Foundations shall be designed for a Factor of Safety of **greater than 2.0** for Normal Condition and **1.65** for Short Circuit Condition / Broken Wire Condition against Sliding, Overturning, and Pull Out.

10.3 ADMIXTURES AND ADDITIVES:

10.3.1 Only approved Admixtures shall be used in the Concrete for the Works. When more than one Admixture is to be used, each Admixture shall be batched in its own batch and added to the mixing Water separately before discharging into the Mixer. Admixtures shall be delivered in suitably Labelled Containers to enable identification.

10.3.2 Admixture in Concrete shall conform to IS: 9103. The Water Proofing Cement Additives shall conform to IS: 2645. Concrete Admixture / Additives shall be approved by Purchaser.

10.3.2.1 The Bidder may propose and the Purchaser may approve the use of a Water - Reducing Set - Retarding Admixture in some of the Concrete. The use of such an Admixture will not be approved to overcome problems associated with inadequate Concrete Plant Capacity or improperly planned placing operations and shall only be approved as an aid to overcoming unusual circumstances and placing conditions.

10.3.3 The Water Reducing Set Retarding Admixture shall be an approved Brand of Ligno - Sulphonate Type Admixture.

10.3.4 The Water Proofing Cement Additives shall be used as required / advised by the Purchaser.

10.4 HOT AND COLD WEATHER REQUIREMENTS:

- 10.4.1 As per relevant Code, during Hot Weather, precautions shall be taken to avoid premature stiffening of the fresh mix and to reduce Water absorption and evaporation losses and when the temperature of the surrounding Air is higher than 30 degree Centigrade, the following shall apply unless otherwise approved by the Purchaser: -
- a) The Form Work shall be continuously sprayed with cold water in advance of concreting and excess Water shall be removed from inside the Forms immediately prior to placement of Concrete.
 - b) The Reinforcement and the Formwork (if Metal Forms are used) shall be protected from the effect of hot winds and direct sunlight.
 - c) Suitable Barriers shall be provided to protect the freshly placed Concrete from Wind until the Concrete is sufficiently hard.
 - d) The Concrete when placed shall be maintained at a temperature of less than 30 degree Centigrade by the use of chilled Water or by spraying the aggregate with cold Water.
 - e) The Concrete shall be mixed, transported, placed, and consolidated, as rapidly as possible and shall then be covered with an Impervious Membrane or Wet Hessian until moist curing beings.
- 10.4.2 During Hot Weather (Atmospheric Temperature above 40 degree Centigrade) or Cold Weather (Atmospheric Temperature at or below 5 degree Centigrade), the Concreting shall be done as per the procedure set out in IS: **7861** (Part – I and II).

11.0 BRICK WALL PANELLED / CHAIN LINK FENCE AND GATES:

11.1 GENERAL:

Brick Wall Paneled and Chain Link Fence shall be designed for the most Critical Loading combination taking care of Wind Force, Stability, Tension on Wires, Minimum Requirements as per this Clause and relevant IS Recommendations.

11.2 AREAS REQUIRING FENCING:

Fencing shall be provided for the following Areas: -

1. Boundary Wall along the Employer's Property Line with Main Gate and Security Check Post.
2. Site fencing for the complete Sub Station complete with Barbed Wires on top. Separate Gates shall be provided for Men and Equipment.
3. Internal Fence surrounding the various Equipment (if) mounted on Ground or a height lower than 2.50 meters without Barbed Wires on top. Necessary Gates shall be provided for each Area so surrounded.

Wherever necessary Anti - Reptile Fixture / Arrangement shall be provided along with Fencing.

11.3 PRODUCT MATERIALS:

The Minimum Requirements are as follows: -

1) **CHAIN LINK FENCE FABRIC** in accordance to IS: 2721.

A	Size of Mesh	50mm
B	Size of Coated Wire	3.15 mm diameter
C	Width of Chain Link	2400mm
D	Class of Zinc Coating	medium
E	Zinc Coated after Weaving	

2) **POSTS:**

	ANGLE SECTION	SPACING mm
Intermediate	L 50 x 50 x 6	2500
Straining Posts	L 65 x 65 x 6	2500
Stay Post	L 45 x 45 x 6	2500

All Structural Steel shall conform to IS: 2062 and shall be painted with a coat of approved Steel Primer and two or more Coats of Synthetic Enamel Paint.

The Chain Link Fabric shall be fixed to the Post at the top and bottom of the **Fence by welding / fixing L50x50x6 Angle Section and 50 x 6 mm M. S. Flat all through its length.**

3. Fencing shall be of Galvanized Barbed Wire Barbed wire shall conform to IS: 278. The Barbed Wire shall consist of two Splices per Reel. The Barbed Wire shall be formed by twisting two line wires, one containing the barbs. The Barbed Wire shall be designated as A – 4, IS: 278 and shall be galvanized.
4. Above Chain Link, 3 Rows (6 Nos. / 3 Nos.) With cross of Barbed Tape / Wire shall be provided in each arm of the Y Shaped Barbed Arm at top With Barbed Tape / Wire above the Chain Link Fence, the Total Fence Height shall be minimum 3,000 mm above Finished Ground Level.
5. Barbed Tape / Wire shall be same for Intermediate and Straining Post.
6. Fasteners, Single Strand Aluminium or Galvanized Steel Wire conforming to requirements for Fence Fabric 4 mm diameter.
7. TENSION WIRE: Single Strand, High Tensile, Galvanized Steel Wire, 4 mm diameter.
8. FITTINGS AND HARDWARE: Cast Aluminium Alloy or Galvanized Steel, Malleable or Ductile Cast Iron, Turnbuckles to be drop forged.

9. For every 50 Reels or part thereof, Samples of the Barbed Tape / Wire and the individual Line Wires shall be put to Tensile Test and in case of failure to conform to the Tensile Properties given below; two Additional Tests of each kind shall be made on the samples cut from other Reels.

**TENSILE
PROPERTIES:**

Breaking Load of Line Wire	Minimum	216 kg
	Maximum	302 kg
Minimum Breaking Load of complete Barbed Wire / Tape	444 kg	

Based on Results of these Additional Tests, the Whole or Portion of the Barbed Wire / Tape shall be accepted or discarded by the Purchaser, as the case may be.

10. G. I. Chain Link Mesh shall be as per IS: 2721, Mesh size 50 mm and Nominal Wire size shall be 3.15mm diameter.

11.4 INSTALLATION:

- 11.4.1 Fence / Boundary Wall shall be installed along the Switchyard Line.
- 11.4.2 Post Holes shall be excavated by approved Methods.
- 11.4.3 Intermediate Posts shall be spaced 2.5 meters apart measured parallel to Ground Surface.
- 11.4.4 Straining Posts shall be installed at equal intervals not exceeding 25.0 meters.
- 11.4.5 Straining Posts shall be installed at sharp changes in Grade, at Corners, at change of Direction and where directed.
- 11.4.6 All Corner Post will have two Stay Posts and every tenth Post will have a Transverse Stay Post.
- 11.4.7 Posts shall be set in M: 20, Plain Cement Concrete Blocks of minimum dimension 400 mm x 400 mm x 1,200 mm depth 75 mm thick Plain Cement Concrete shall be provided below Concrete Block. Concrete Work shall conform to relevant Clause. Posts shall be braced and held in plumb position and true alignment and elevation until Concrete has set.
- 11.4.8 Fence Fabric shall not be installed until Concrete has cured a minimum of 7 days.
- 11.4.9 Bottom and Top of the Fence Fabric shall be fixed with Angle Section of 50x50x6 And MS Flats of 50 mm x 6 mm (min).
- 11.4.10 Fence Fabric shall be laid out with barbed edge on top, stretched tightly, and shall be fastened to Intermediate, Gate, and Straining Post with 50 x 6 Flats.

- 11.4.11 Fabric shall be secured to Tension Wires with tie wires at 400 mm intervals. Tie Wires shall be given not less than two twists.
- 11.4.12 Barbed Tape shall be spliced with Standard Wire Splices.
- 11.4.13 Barbed Tape shall be stretched to have uniform tension.
- 11.4.14 Barbed Tape shall be attached to Barbed Wire Arms with approved Metal Clips.
- 11.4.15 A 230 mm or one Brick thick Toe Wall of Brick / Rubble Masonry or Concrete with notches over 75 mm thick P. C. C. (1: 2: 4) shall be provided below all Fencing and shall be minimum 200 mm above and 500 mm below Finished Ground Level. All Exposed Surfaces of Brick Toe Wall shall be provided with 15 mm, 1: 4 Cement Sand Plaster and coated with two Coats of Colour Wash with a Base Coat of White Wash with Lime.

11.5 **GATES:**

- 11.5.1 The Gate shall be made of Medium Duty M. S. Pipe conforming to relevant IS with welded Joints.
- 11.5.2 The Gates shall be fabricated with Welded Joints to achieve rigid connections. The Gate Frames shall be painted with one Coat of approved Steel Primer and two Coats of Synthetic Enamel Paint.
- 11.5.3 Gates shall be fitted with approved quality Iron Hinges, Latch, and Latch Catch. Latch and Latch Catch shall be suitable for attachment and operation of Pad Lock from either side of Gates, Hinges shall permit Gates to swing through 180 degree back against Fence.
- 11.5.4 Gates shall be fitted with Galvanized Chain Hook or Gate Hold Back to hold Gates open. Double Gates shall be fitted with Centre Rest and Drop Bolt to secure Gates in Closed position.
- 11.5.5 Gates shall be installed in locations shown on Drawings. Next to the Main Gate, a Men Gate (1.25 m wide, single leaf) shall also be provided.
- 11.5.6 Bottom of Gates shall be set approximately 40 mm above Ground Surface and necessary Guiding Mechanism shall be fitted.
- 11.5.7 Gates shall be fixed to Structural Steel Post / RCC Column.

12.0 **BUILDINGS - GENERAL REQUIREMENT:**

12.1 **GENERAL:**

The Scope includes the Design, Engineering, and Construction including Anti - Termite Treatment, Plinth Protection DPC of Building including Sanitary, Water Supply and Electrification, False Ceiling etc. The Size and Layout of the Buildings shall be as per requirements of Scope of Work mentioned in Section – 1 (Project) including provision for Future Bays requirement with the approval of the Purchaser. The Building shall be of RCC Framed Structure of M: 25 Grade Concrete (**Minimum**).

12.1.1 CONTROL ROOM and GIS BUILDING

The scope includes design, engineering and construction, including anti-termite treatment, plinth protection, DPC, peripheral drains, water supply, plumbing, sanitation, fire-fighting, electrification etc. of Control Room Building.

The building auxiliary services like air conditioning systems, fire protection and detection systems and all other miscellaneous services shall be designed in accordance with the requirements as specified in relevant section or elsewhere in this Specification. The building shall be constructed as per the design

An open space of 1.0 meter minimum shall be provided on the periphery of the Rows of Panel and Equipment generally in order to allow easy Operator movement and access as well as maintenance

Component REQUIREMENTS

- Control Room
- ACDB & DCDB Room
- Battery Room
- Office Room
- Conference Room
- AHU Room
- Switchgear Room
- SCADA Room
- Pantry Room
- Incharge Room
- Relay Panel Room
- Corridor width
- Portico
- Toilet for Men
- Toilet for Women
- Store Room
- GIS Hall
- Provision of shaft for electrical, sanitary, water supply facilities shall also be kept.

12.1.2 DESIGN:

- a) The Buildings shall be designed: -

1. To the requirements of the National Building Code of India Standards for the specified Climatic and Loading Conditions
 2. To adequately suit, the requirements of the Equipment and Apparatus contained in the Buildings and in all respects to be compatible with the intended use and occupancy with a functional and economical space arrangement.
 3. For a Life Expectancy of Structure, System and Components not less than that of the Equipment, which is contained in the Building, provided regular maintenance be carried out.
 4. To be aesthetically pleasing, Different Buildings shall show a uniformity and consistency in Architectural Design.
 5. GIS floor shall be provided with 62mm Thick Cement concrete (two coat of PU).
 6. To allow for easy access to Equipment and Maintenance of the Equipment With wherever required, Fire Retarding Materials for Walls, Ceilings and Doors which would prevent supporting or spreading of Fire with Materials preventing dust accumulation.
- c) Suitable Expansion Joints shall be provided in the longitudinal direction wherever necessary with provision of Twin Columns.
 - d) Individual Members of the Buildings Frame shall be designed for the worst combination of Forces such as Bending Movement, Axial Force, Shear Force, Torsion etc. Permissible Stresses for different Load Combination shall be taken as per relevant IS Codes.
 - e) All Cable Vaults shall be located above Ground Levels i.e. Cable Vaults shall not be provided as Basements in the Buildings.
 - f) The Building Lighting shall be designed in accordance with the requirements of Relevant Section.
 - g) The Building Auxiliary Services like Air Conditioning and Ventilation Systems, Fire Protection and Detection Systems and all other Miscellaneous Services shall be designed in accordance with the requirements specified in relevant Section or elsewhere in this Tender Document.
 - h) Seismic coefficient Method or Response spectrum method shall be used for seismic analysis of the building for Earthquake forces, as per relevant Indian standard codes (IS 1893)/equivalent International Standards.

12.1.3 DESIGN LOADS:

- 1) Building Structures shall be designed for the most critical combinations of Dead Loads, Super -Imposed Loads, Equipment Loads, Crane Load (if any), Wind

Loads, Seismic Loads , and Temperature Loads.

- 2) Dead Loads shall include the Weight of Structures complete with Finishes, Fixtures, and Partitions and should be taken as per IS: 1911.
- 3) Super Imposed Loads in different Areas shall include Live Loads, Minor Equipment Loads, Cable Trays, Small Pipe Racks / Hangers and Erection, Operation and Maintenance Loads. Equipment Loads shall constitute, if applicable, all Load of Equipment to be supported on the Building Frame.
- 4) For Crane Loads an Impact Factor of 30 % and Lateral Crane Surge of 10 % (Lifted Weight + Trolley) shall be considered in the analysis of Frame according to provision of IS: 875 (Latest revision). The Horizontal Surge shall be 5 % of the Static Wheel.
- 5) The Wind Loads shall be computed as per IS: 875, Seismic Coefficient Method shall be used for the Seismic Analysis as per IS: 1893 (latest revision) with importance factor 1.75
- 6) For Temperature loading, the Total Temperature Variation shall be considered as 2 / 3 of the Average Maximum Annual Variation in Temperature. The Average Maximum Annual Variation in Temperature for the purpose shall be taken as the difference between the Mean of the Daily Minimum Temperature during the Coldest Month of the Year and Mean of Daily Maximum Temperature during the Hottest Month of the Year. The Structure shall be designed to withstand Stresses due to 50 % of the Total Temperature Variation.
- 7) Wind and Seismic Forces shall not be considered to act simultaneously.
- 8) Floors / Slabs shall be designed to carry Loads Imposed by Equipment, Cables, Piping, Travel of Maintenance Trucks and Equipment and other Loads Associated with Building Floors shall be designed for Live Loads as per relevant IS code Cable and Piping Loads not less than 5 kN / sq. m. hanging from the underside shall also be considered additionally for Floors where these Loads are expected.
- 9) In addition, Beams shall be designed for Incidental Point Loads of 20 kN to be applied at any point along the Beams. The Floor Loads shall be subject to Purchaser's approval.
- 10) For consideration of Loads on Structures IS: 875, the following Minimum

Superimposed Live Loads shall, however, be considered for the design: -

a	Roof	For Accessible Roofs 375 kg Uniformly Distributed over any Span of one meter width of the Roof Slab and 900 kg Uniformly Distributed over the Span in the case of all Beams. For Non Accessible Roofs 190 kg Uniformly Distributed over any Span of one meter width of the Roof Slab and 450 kg Uniformly Distributed over the Span in the case of Beams.		
b	RCC Floors	(i)	500 kg / m ²	For Offices Floor
		(ii)	1000 kg / m ² (minimum)	For Equipment Floors or actual Requirement, if higher than 1000 kg / m ² based on Equipment Component Weight and Layout Plans.
c	Stairs and Balconies	500 kg / m ²		
d	Toilet Rooms	200 kg / m ²		
e	Chequered Plate Floor	400 kg / m ²		
f	Walkways	300 kg / m ²		

Any Additional Load coming in the Structure shall be calculated as per IS: 875.

12.1.4 SUBMISSION:

The following information shall be submitted for review and approval to the Purchaser: -

1. Design Criteria shall comprise the Codes and Standards used, applicable climatic data including Wind Loads, Earthquake Factors, Maximum and Minimum Temperature applicable to the Building Locations, assumptions of Dead and Live Loads, including Equipment Loads, Impact Factors, Safety Factors and other relevant information.
2. Structural Design Calculations including Computer Aided Analysis, Designs Results and Drawing (including Construction / Fabrication) for all Reinforced Concrete and Structural Steel Structures.
3. Fully dimensioned Concept Plan including Floor Plans, Cross Sections, Longitude Sections, Elevations, and perspective View of each Building. These Drawings shall be drawn at a Scale not smaller than 1: 50 and shall identify the Major Building Components.

4. Fully dimensioned Drawings showing Details and Sections drawn to Scales of sufficient size to clearly show Sizes and Configuration of the Building Components and the relationship between them.
5. Product Information of Building Components and Materials, including Walls Partitions, Flooring, Ceiling, Roofing, Doors and Windows and Building Finishes.
6. A detailed Schedule of Building finishes including Colour Schemes.
7. A Door and Window Schedule showing Door Types and Locations, Door Lock Sets, Latch Sets and other Door Hardware.

8. Manufacturer detail of Cement, Steel and Admixture.

Approval of the above information shall be obtained before ordering Materials or starting Fabrication or Construction as applicable.

12.2 FINISH SCHEDULE:

The Preliminary Indicative Finishing Schedule is given in subsequent Clause. However, at the time of Detailed Engineering, the Purchaser reserves the right to alter the Finishing Schedule and Specifications and such changes shall have No Additional Financial Implication whatsoever to the Purchaser.

1. All walls shall be non-load bearing in filled panel walls, in brickwork as per the specification Minimum thickness of external walls shall be 230 mm with 1:6 cement sand mortar. Partition walls if any shall be of 115 mm thick brick masonry in cement sand mortar (1:4) all external walls shall be provided with insulation of 80 mm puff panels (wood look paint) as per specifications of puff panels with an air gap of 40mm fixed with suitable tie members, opening for windows/ventilators/exhaust fans shall be maintained and sealed on sides.
2. All Floor/Roof slabs shall be regular beam slab construction. However, sunken RCC slab shall be provided in toilet areas as per the requirement.
3. False ceiling as per requirement shall be provided as detailed in Table-1 (Detailed Finish Schedule).
4. Minimum height of skirting above finished floor level shall be 150 mm. The skirting material shall match with the floor finish.
5. Minimum height of the parapet walls shall be 750 mm.
6. Ground floor finish shall be laid over 20 mm thick cement sand mortar, 100 mm thick plain cement concrete (PCC) 1:5:10 (1 cement: 4 sand : 8 stone aggregates), 100 mm thick local sand filling. The earth below ground floor shall be well rammed before laying sand filling.
7. First floor details shall comprise of finish as per schedule, 20 mm cement sand mortar and 50mm thick PCC(1:5:10) over RCC slab

12.3 FLOORING:

Flooring in various Rooms of Control Room building shall be as under: -

a	GIS HALL & AHU Room	62mm Thick Cement concrete (two coat of PU)
b	Battery Room	Acid Resistance tile
c	Passage	Vitrified Tile
d	A. C. & D.C Distribution Panel Room	--do--
e	SCADA Room, Relay room	--do--
f	Office Rooms	Vitrified Tiles
g	TOILET	Anti skid Vitrified Tiles

12.4 SKIRTING:

Skirting Height shall be 150 mm in all Rooms except W. C. where it shall be 2,100 mm. Skirting Material shall match to the corresponding Floor.

12.5 WALLS:

Control Room Building shall be Framed Superstructure. All Walls shall be Non Load Bearing Wall. Minimum Thickness of External Walls shall be 230 mm (One Brick) with 1: 4 Cement Sand Mortar.

12.6 PLASTERING:

All Internal Walls shall have Minimum 15 mm thick 1: 4 Cement Sand Plaster The Ceiling shall have 6 mm thick 1: 3 Cement Sand Plaster

12 mm thick, pre - laminated three layer Medium Density (Exterior Grade) Particle Board Grade - I, Type II conforming to IS: 12823 bonded with Phenol Formaldehyde Synthetic Resin, of approved Brand and Manufacture shall be provided in panelling fixed in Aluminium Doors, Windows, Shutters and Partition Frames with C. P. Brass / Stainless Steel Screws etc for Control Room complete as per directions of Engineer - in - Charge.

12.7 Distemping on all Internal Walls and Ceilings shall be with Oil Bound Washable Distemper of approved Brand and Manufacture to give an even shade (two or more coats) over and including Priming Coat with Cement Primer for Control Room.

12.8 Plaster of Paris (Putty) of 2 mm thickness over the Plaster Surface to prepare the surface even and smooth complete with distemping with First Quality Oil Bound Washable Distemper (Ready Mix) of approved Manufacturer with two or more coats of new work of required Shade and Colour complete as per Manufacturer's

Specification shall be provided.

12.9 Two or more Coats of French Spirit Polishing with a coat of Wood Filler shall be provided on the Wooden Doors.

12.10 Enamel Painting with Synthetic Enamel Paint of approved Brand and Manufacture of required colour to give an even shade shall be provided on the Steel Glazed Doors, Windows, Ventilators, and Rolling Shutters in various Buildings. Two or more Coats over an Under Coat of suitable Shade with Primer Paint of approved Brand and Manufacture shall be provided.

12.11 **EXTERNAL FINISH:**

All External Surfaces shall have 20 mm thick Cement Sand Plaster in two Layers. **Under Layer 12 mm thick Cement Plaster** 1: 4 (1 Cement: 4 Coarse Sand) and a Top Layer 8 mm thick Cement Plaster 1: 3 (1 Cement: 3 Coarse Sand) mixed with Water Proofing Compound in the ratio as recommended by the Manufacturer.

All Ceilings shall be White Washed.

All Internal Walls shall have Oil Bound Washable Distemper.

All External Walls shall have Water Proofing (Enamel Paint).

Exterior Architecture finish shall be specially taken care to provide attractive finish and shall be approved by the Purchaser.

12.12 **ROOF:**

Roof of the Control Room Building shall consist of cast - in - situ RCC Slabs. Extra Heavy Water Proofing Treatment shall be done after grading under bed with 1: 4 Cement Sand Plaster of 25 mm thickness. The Under Bed shall be laid to provide an ultimate run off gradient of **1: 120**.

The Extra Heavy Water Proofing Treatment shall consist of the following operations:

- a. Applying and Grouting a slurry coat of neat Cement using 2.75 kg / sq. m of Cement admixed with proprietary Water Proofing Compounds conforming to IS: 2645 over the RCC Slab including cleaning the Surface before Treatment
- b. Laying Cement Concrete using broken Bricks / Brick Bats 25 mm to 100 mm size with 50 % of Cement Mortar 1: 4 (1 Cement: 4 Coarse Sand) admixed with Proprietary Water Proofing Compound conforming to IS: 2645 over 20 mm thick layer of Cement Mortar of minimum 1: 4 (1 Cement: 4 Coarse Sand) admixed with Proprietary Water Proofing Compound conforming to IS: 2645 to required Slope and treating similarly the adjoining Walls upto 300 mm height including rounding of junctions of Walls and Slabs
- c. After two days of proper curing, applying a second coat of Cement Slurry admixed with Proprietary Water Proofing Compound conforming to IS: 2645
- d. Finishing the Surface with 20 mm thick Joint less Cement Mortar of Mix 1: 4 (1 Cement: 4 Coarse Sand) admixed with Proprietary Water Proofing Compound

conforming to IS: 2645 and finally finishing the Surface with trowel with neat Cement Slurry and making of 300 x 300 mm square

- e. The Whole Terrace so finished shall be flooded with Water for a minimum period of Two Weeks for curing and for final Test. All above operations to be done in order and as directed and specified by the Engineer - in - Charge
- f. Hot Bitumen applied @ 1.6 kg / sq. m. minimum.
- g. Hessian - Base - Self - Finished Felt Type 3 grade 1
- h. Pea Sized Gravel at the rate of 0.006 cu. m. / sq. m
- i. Tile Terracing as per relevant IS Specification

12.13 GLAZING:

Sun Film shall be provided for all Windows / Doors. Minimum Thickness of Glazing shall be 5.5 mm.

12.14. FALSE CEILING:

The Control Room and all other A. C. Areas shall have Closed Aluminium Ceiling System comprising 84 mm wide, 12.5 mm deep Panels of approved Colour with a Recessed Flange of 23.9 mm Roll formed out of 0.5 mm thick Aluminium Alloy AA 5050 / 5052 / 3003 achromatized and Stove Enamelled on both sides Panels to be fixed on Roll Formed Carriers 32 mm wide, 39 mm deep out of minimum 0.9 mm thick Aluminum Alloy Strip with cut outs to hold Panels in module of 100 mm minimum at maximum 1.60 m c / c carrier suspended from Roof by 4 mm diameter Galvanized Steel Wire Rod, Hangers with special Height Adjustment Springs / Clips made out of Spring Steel at Maximum Spacing of 1.50 m c / c Hangers fixed 25 mm thick Resin Bonded Mineral Wool of approved quality encased in 100 micron Block Polythene and laid over Top of placed, Panels, all complete. The System is to be got approved from Purchaser before installation

12.15 UNDER DECK INSULATION:

- 12.15.1 The Method of Fixing shall consist of slotted M. S. Angles 75 x 50 x 4 mm fixed to soffit of RCC Roof Slab at 600 mm center to center in both directions by Rawl Plugs of adequate strength. The Slots shall have 14g G. I. Tie Wire drawn through them.
- 12.15.2 50 mm thick Insulation Mat Fiberglass Crown - 100 or equivalent shall be made out of Fiberglass or approved equivalent conforming to IS: 8183, backed with 34g Aluminum Foil and 22g x 12 mm Mesh Wire Netting. The Net shall be stretched tightly across the Slotted Angles or Slotted Plates holding it in place by means of Wires. The Joints of the Wire Netting shall be butted and tightly laced down with 14g G. I. Wire. The System shall be got approved from Engineer - in - Charge.

12.16 DOORS, WINDOWS, VENTILATORS, AND ROLLING SHUTTERS:

The Doors and Windows of the Control Room shall be of Aluminum in accordance with the relevant IS Codes (latest) mentioned in the following Clause(s).

The Air Conditioned Area shall be Double Toughened Glass and Doors suitably made to have efficient Air Conditioning.

Other Doors and Windows shall be of Aluminum as per relevant IS Codes.

12.16.1 **DOORS, WINDOWS, AND VENTILATORS DETAILS:**

The Work includes providing and fixing Fully Glazed Anodized Aluminum Partitions, Doors, Windows and Ventilators for Control Room and other Structures as shown on the Drawing and as directed by the Engineer - in - Charge.

The Work shall conform to the latest revision of the following IS Specifications: -

IS: 1285 Wrought Aluminum and Aluminium Alloy Extruded Round Tube and Hollow Sections (For General Engineering Purpose)

IS: 1948 Specifications for Aluminium Doors, Windows and Ventilators

IS: 1081 Code of Practice for Fixing and Glazing of Metal (Steel and Aluminium) Doors Windows and Ventilators

Aluminium Alloy used in manufacture of Extruded Sections shall conform to IS: 1285. All Aluminium Extruded Sections shall be of Standard Make and shall be Heavily Anodized with thickness of Anodic Film not less than 15 Microns. The Anodizing shall be in Mat Finish or Glaze Finish as directed by the Engineer - in - Charge.

The Weight of the different Rectangular / Tubular Sections shall not be less than 1.60 kg / m for Fixed Portion, Top Horizontal, and Outer Frame of open able Door, 2.10 kg / m for Bottom Horizontal and Verticals and 0.90 kg / m for Middle Sections. Weight for Frames of Fixed Windows and Ventilators shall not be less than 0.56 kg / m. For Sliding Windows, Window Frame on Top and Sides shall not be less than 0.80kg/m.

The Window Frame Bottom for the Case shall be minimum 1.14 kg/ m. Window Shutter Frames and Shutter Interlocks shall be minimum 0.49 kg / m.

These Weights are for General Guidance and Weights of Sections per meter may vary from Make to Make Handles, Tower Bolts, Locks, Cleats, Beading, Floor Springs, Hinges, and all other Fixtures shall be of approved Make and Quality. The Glass and Glazing shall be plain 5.50 mm thick for Partitions, Doors, and Ventilators and shall be free from flaws, specks, and bubbles. All Cut Glass shall have straight edges and square corners.

The Frames shall be square and flat. The Door Shutters shall be provided with PVC /

Neoprene Weather Stripping and PVC / Neoprene Gaskets shall be used for Glazing Beads. Each Door shall be fitted with two suitable sizes Anodized Aluminium Handles.

The Measurement for Payment will be based on Area of Work. The Measurement will be taken from Outside to Outside of the Frame Work. The Unit Rate Quoted shall include Cost of all Materials, Fixtures, Labour, Transportation, Storage, Fixing, and Cleaning etc., with leads and lifts.

Sl. No.	LOCATION	FLOORING & SKIRTING 150 MM HIGH	WALL (INTERNAL)	CEILING	DOOR, WINDOWS & VENTILATOR
1.	Control Room	Vitrified tiles 8mm thick size 600 x 600mm	Premium acrylic emulsion paint on smooth surface applied with plaster of Paris (2 mm thick)	White wash above False Ceiling*	Windows shall be powder coated aluminium frames of 5.5 mm double glass, hermetically sealed with air gap of 40 mm by using suitable patch fittings/spider fittings. The glass shall extend horizontally from column to column and vertically from sill level of 0.75 m to bottom of lintel/roof beam. All doors shall be glazed powder coated aluminium doors and frames with 5.5mm Thick double glazing & hermetically sealed.
2.	Conference Room	Vitrified tiles 8mm thick size 600 x 600mm	Premium acrylic emulsion paint on smooth surface applied with plaster of Paris (2 mm thick)	White wash above False Ceiling*	Windows shall be of powder coated aluminium frames with 5.5 mm Thick double glazing & hermetically sealed. All doors shall be glazed powder coated aluminium doors with 5.5mm Thick double glazing & hermetically sealed.
3.	S/S In-charge Room.	Vitrified tiles 8mm thick size 600 x 600mm	Premium acrylic emulsion paint on smooth surface applied with plaster of Paris (2 mm thick)	White wash above False Ceiling*	Windows shall be of powder coated aluminium with 5.5mm Thick double glazing & hermetically sealed. All doors shall be glazed powder coated aluminium doors with 5.5mm Thick double glazing & hermetically sealed.
4	Office Rooms	Vitrified tiles 8mm thick size 600 x 600mm	Premium acrylic emulsion paint on smooth surface applied with plaster of Paris (2 mm thick)	White wash above False Ceiling*	Windows shall be of powder coated aluminium with 5.5mm Thick double glazing & hermetically sealed. All doors shall be glazed powder coated aluminium doors with 5.5mm

Sl. No.	LOCATION	FLOORING & SKIRTING 150 MM HIGH	WALL (INTERNAL)	CEILING	DOOR, WINDOWS & VENTILATOR
					Thick double glazing & hermetically sealed.
5.	Electrical/ Electronic Test Lab./Telecom Room	Vitrified tiles 8mm thick size 600 x 600mm	Premium acrylic emulsion paint on smooth surface applied with plaster of Paris (2 mm thick)	White wash above False Ceiling*	Windows shall be of powder coated aluminium with 5.5mm Thick double glazing & hermetically sealed. All doors shall be glazed powder coated aluminium doors with 5.5mm Thick double glazing & hermetically sealed.
6.	ACDB & DCDB Room	62mm thick cement concrete flooring with metallic hardener topping. Skirting shall be of cement sand plaster.	Oil bound washable distemper on smooth surface applied with plaster of Paris putty	Oil bound washable distemper on smooth surface applied with plaster of Paris putty	Steel door 45mm thick double sheet 18-gauge MS steel suitably reinforced and filled with mineral wool. Windows/ventilator shall be of powder coated aluminium with 4mm glazing.
7.	Battery Room	Vitrified tiles 8mm thick size 600 x 600mm	Premium acrylic emulsion paint on smooth surface applied with plaster of Paris (2 mm thick)	White wash above False Ceiling*	Steel door 45mm thick double sheet 18-gauge MS steel suitably reinforced and filled with mineral wool. Windows/ventilator shall be of powder coated aluminium with 4mm glazing.
8.	Reception /Lobby	Vitrified tiles 8mm thick size	Premium acrylic emulsion paint on smooth surface	Oil bound washable distemper on smooth	Windows shall be of powder coated aluminium with 5.5mm Thick double glazing & hermetically sealed. All doors

Sl. No.	LOCATION	FLOORING & SKIRTING 150 MM HIGH	WALL (INTERNAL)	CEILING	DOOR, WINDOWS & VENTILATOR
		600 x 600mm	applied with plaster of Paris (2 mm thick)	surface applied with plaster of Paris putty	shall be glazed powder coated aluminium doors with 5.5mm Thick double glazing & hermetically sealed.
9.	Corridor	Vitrified tiles 8mm thick size 600 x 600mm	Premium acrylic emulsion paint on smooth surface applied with plaster of Paris (2 mm thick)	Oil bound washable distemper on smooth surface applied with plaster of Paris putty	Windows shall be of powder coated aluminium with 5.5mm Thick double glazing & hermetically sealed. All doors shall be glazed powder coated aluminium doors with 5.5mm Thick double glazing & hermetically sealed.
10.	Portico	Cast-in-situ 40 mm thick Cement concrete (1:2:4) with 18mm granite flooring	Granite cladding	Oil bound washable distemper on smooth surface applied with plaster of Paris putty	All doors shall be glazed powder coated aluminium doors with 5.5mm Thick double glazing & hermetically sealed.
11.	Toilet	Ceramic tiles	Vitrified tiles 8mm thick size 600 x 600mm	Oil bound washable distemper	Windows/ ventilator shall be of powder coated aluminium with 5.5mm Thick double glazing & hermetically sealed. All doors shall be flush door shutters made of pre-laminated particle board with powder coated aluminium frame.

Sl. No.	LOCATION	FLOORING & SKIRTING 150 MM HIGH	WALL (INTERNAL)	CEILING	DOOR, WINDOWS & VENTILATOR
12.	Janitor room	Ceramic tiles with white cement	DADO glazed tile 2100mm high, oil bound washable distemper above DADO	Oil bound washable distemper	Windows/ ventilator shall be of powder coated aluminium with 5.5mm Thick double glazing & hermetically sealed. All doors shall be flush door shutters made of pre-laminated particle board with powder coated aluminium frame.
14.	Panel/ Relay Room/ Communication Room	Vitrified tiles 8mm thick size 600 x 600mm	Non VOC acrylic emulsion paint over 2mm POP putty upto false ceiling over approved primer coat	False ceiling Painted with Non VOC acrylic emulsion paint even shade.	All doors, windows, ventilators shall be of UPVC with minimum 5.5mm Thick double glazing & hermetically sealed.
15.	AHU Room	62mm thick cement concrete flooring with hardner	Non VO C acrylic emulsion paint over 2 mm POP Putty up to false ceiling over approved primer coat over plastered surface.	RCC ceiling with Non-VOC acrylic emulsion paint over approved primer coat.	All windows, ventilators shall be of UPVC with minimum 5.5mm Thick double glazing & hermetically sealed. All doors shall be flush door shutters (35mm thick block board with commercial veneer on both sides with Lipping) with powder coated aluminium frame.

12.16.2 ROLLING SHUTTER:

The Main Entrance to the Control Room Building shall have Aluminium Frame Door

as well as Rolling Shutter. Specification includes providing and Fixing Mild Steel Push and Pull Type of Rolling Shutter of clear dimension 3.5 x 3.5 meters including all necessary Fixtures, Painting etc complete for the Maintenance to the Control Room Building. Providing, Fabricating and Fixing of Rolling Shutters shall conform to the latest revision of IS: 6248 Metal Rolling Shutters and Rolling Grills.

The Rolling Shutters shall be fabricated from 18 SWG x 7.5 cm M.S. Steel Laths.

M.S. Rolling shutters shall be provided and fixed interlocked together through their entire length and jointed together at the end by end locks mounted on specially designed Pipe Shaft with Brackets along with Ball Bearing for Rolling Shutter, Side Guides and arrangements for inside and outside locking with Push and Pull Operation including the cost of providing and fixing necessary 27.5 cm long Wire Springs Grade No. 2 and M. S Top Cover of required thickness for Rolling Shutters. 80 x 1.25 mm M. S Laths with 1.25 mm thick Top Cover. The Material and Manufacture shall be subjected to the approval of Employer. The Rolling Shutter shall be in one part, as and where directed by Engineer - in - Charge with adequate operation mechanism. For the Rolling Shutter, provision shall be made for a wicket door of size 1.2 meters x 1.8 meters or as directed by the Engineer - in - Charge for the normal movement. The Shutter shall have a Grill Portion for about 1.5 meters depth from the Top or as directed by the Engineer - in - Charge. Painting shall comprise of two coats of approved quality Synthetic Enamel Paint over a Base Coat of Zinc Chromate / Red Oxide Primer. The Area shall be measured as Clear Width multiplied by Clear Height of the Opening as seen from outside and shall be paid in units of square meter. The Unit Price Quoted for this Item shall include Cost of all Materials, Labour, Machinery, Fittings and Fixtures, Other Fixtures for, Manual Operation, Roller Bearing, including Painting etc complete.

12.17 OTHER BUILDINGS:

The Area Requirement for other Buildings shall be as per Detailed Engineering. The Specification of Control Room Buildings shall be followed to the extent applicable for other Buildings.

13.0 STORM WATER DRAINAGE:

13.1 The RCC Type Building Drain shall be provided for the collection of Storm Water from the Roofs. This Water shall be collected in Junction Boxes and these Boxes shall drain to the Main Drainage System of the Sub Station.

13.2 All Drains inside the Buildings shall have minimum 40 mm thick Grating Covers and in Areas where Heavy Equipment Loads would be coming, Pre - Cast RCC Covers shall be provided in place of Steel Grating.

13.3 For all Buildings, suitable arrangement for draining out Water collected from Equipment Blow Down, Leakages, Floor Washings, Fire - Fighting etc shall be provided for each Floor.

- 13.4 For Switchyard Area Peripheral Storm Water, Drain of 1.5 meters wide and 1.0 meter deep shall be constructed Outside the Boundary of the Switchyard and interconnected with the Inside Drainage from Cable Trenches, Building and Roads and Outside Storm Water System of Area.
- 13.5 1) Storm Water Drain shall be RCC Type 2) Open storm water drains shall be provided on both sides of the Roads. Bidders are requested to quote as per the provision of the Price Schedule. 3) Pipe drains, concrete pipe of class NP2 shall be used. However, for road crossings higher strength pipe of class NP3 shall be provided and for Rail crossings NP4 class shall be provided. 4) The drain shall be given a minimum slope of 1:500 in the Longitudinal direction. The drain outflow point shall be decided during detailed engineering and after finalization of Contour Survey & GA Layout.
- 14.0 MISCELLANEOUS GENERAL REQUIREMENTS:**
- 14.1 Dense Concrete with controlled Water Cement Ratio as per IS Code shall be used for all Underground Concrete Structures such as Pump House, Tanks, Water Retaining Structures, Cable and Pipe Trenches etc for achieving Water Tightness.
- 14.2 All Joints including contraction and expansion Joints for the Water Retaining Structures shall be made watertight by using PVC Ribbed Water Stops with Central Bulb. However, Kicker type (externally placed) PVC Water Stops shall be used for the Base Slab and in other Areas where it is required to facilitate concreting. The Minimum Thickness of PVC Water Stops shall be 5 mm and Minimum Width shall be 230 mm.
- 14.3 All Steel Sections and Fabricated Structures, which are required to be transported on sea shall be provided with anti-corrosive paint to take care of sea worthiness.
- 14.4 All Mild Steel Parts used in the Water Retaining Structures shall be Hot Double Dip Galvanized. The Minimum Coating of the Zinc shall be 750gm/sq.m. for Galvanized Structures and shall comply with IS: 2629 and IS: 2633. Galvanizing shall be checked and tested in accordance with IS: 2633. The Galvanizing shall be followed by the application of an etching primer and dipping in black bitumen in accordance with BS: 3416.
- 14.5 A Screed Concrete Layer not less than 100 mm thick and of grade not weaker than M: 20 conforming to IS: 456 - 2000 shall be provided below all Water Retaining Structures. A Sliding Layer of Bitumen Paper or Craft Paper shall be provided over the Screed Layer to destroy the bond between the Screed and the Base Slab Concrete of the Water Retaining Structures.
- 14.6 Bricks having minimum 105 kg / cm² Compressive Strength can only be used for Masonry Work. Bidder shall ascertain himself at Site regarding the availability of Bricks of minimum 105 kg / cm² Compressive Strength before submitting his Bid.
- 14.7 Doors and Windows on External Walls of the Buildings (other than Area provided

with Insulated Metal Claddings) shall be provided with RCC Sun Shade over the openings with 300 mm Projection on either side of the openings. Projection of Sun Shade from the Wall shall be minimum 450 mm over Windows Openings and 750 mm over Door Openings.

- 14.8 All Stairs shall have Maximum Riser Height 150 mm and a Minimum Tread Width of 300 mm. Minimum Width of Stairs shall be 1500 mm
- 4.9 Angles 50 x 50 x 6 mm (minimum) with Lugs shall be provided for Edge Protection all round cut outs / openings in Floor, Slab, Edges of Drains supporting Grating Covers, Edges of RCC Cable / Pipe Trenches supporting Covers, Edges of Man Holes Supporting Covers, Supporting Edges of Man Holes Pre - Cast Cover and any other place where breakage of corners of Concrete is expected.
- 14.10 Anti Termite Chemical Treatment shall be given to Columns, Pits, Walls, Trenches, Foundations of Buildings, Filling below the Floors etc as per IS: 6313 and other relevant Indian Standards.
- 14.11 Hand Railing minimum 900 mm high shall be provided around all Floor / Roof Openings, Projections / Balconies, Walk Ways, Platforms, Steel Stairs etc. All Hand Rails and Ladder Pipes shall be 32 mm nominal bore M. S. Pipes (Medium Class) and shall be galvanized (Medium Class as per IS: 277). All Rungs for Ladder shall also be galvanized as per IS: 277 Medium Class.
- For RCC Stairs, Hand Railing with 20 mm square M. S. Bars, Balustrades with suitable M. S. Flat and Wooden Handrails shall be provided as per direction of Engineer - in - Charge.
- 14.12 LATTICE STRUCTURES (GALVANIZED): Design and Drawings for Supporting Structures for GIB Duct, 220kV and 33kV Outdoor equipments and lightening mast shall be in Lattice Steel Structure. The GRADE A steel to be used for the Lattice Structures and other outdoor structure Equipments.

15.0 TECHNICAL DETAILS OF THE BUILDINGS:

- 15.1 Polished Vitrified Tiles in 60 x 60 cm size (thickness to be specified by the Manufacturer) in Flooring and Skirting, with water absorption's less than 0.08 % and conforming to IS: 15622 of Approved Make in all Colours and Shades, laid on Cement Mortar 20 mm thick for Flooring and 12 mm thick for Skirting 1:4 (1 Cement: 4 Coarse Sand) including grouting the Joints with white Cement and Matching Pigments etc complete.
- 15.2 Glazed Ceramic Floor Tiles 300 x 300 mm (thickness to be specified by the Manufacturer) of 1st quality conforming to IS: 15622 of approved Make in Colours as approved by Engineer - in - Charge in Toilet and Pantries Area on 20 mm thick Cement Mortar 1:4 (1 Cement: 4 Coarse Sand) including grouting the joints with White Cement and matching pigments etc complete.
- 15.3 Ceramic Glazed Wall Tiles of 1st quality conforming to IS: 15622 (thickness to be

- specified by the Manufacture) of approved Make in all Colours, Shades as approved by Engineer - in - Charge in Skirting, Risers of Steps and Dados over 12 mm thick bed of Cement Mortar 1:3 (1 Cement: 3 Coarse Sand) and jointing with Grey Cement Slurry @ 3.3 kg per sq. m. including pointing in White Cement Mixed with pigment of matching shade complete.
- 15.4 Pre - Cast Terrazzo Tiles 20 mm thick with Graded Marble Chips of sizes upto 12 mm laid in Floors, Landings, Skirting and Riser of Light Shade using White Cement jointed with Neat Cement Slurry Mix with pigment to match the Shade of the Tiles including Rubbing and Polishing complete with pre - cast Tiles on Cement Mortar 1:4 (1 Cement: 4 Coarse Sand) with (20 mm thick for Flooring and 12 mm thick for Skirting).
- 15.5 18 mm Polished Granite in Cement Mortar 1:4, 20 mm thick made to a level cut to size shall be provided and the joints are filled with jointing compound matching to the tiles. Wherever Granite Tiles are specified for the Floor, 100 mm Granite Skirting shall be provided with the Walls. The Granite outer surface shall be flushed to the plaster finish of the Wall.
- 15.6 Granite Counter shall be provided and fixed with 18 mm Granite Slab mounted on 75 mm RCC Slab supported by 115 mm Brick Wall Plastered on all sides. The Shelves shall be made of 18 mm thick well - cut and polished White Marble Slabs. The outer side of the Brick Wall and the RCC Slab visible in the front shall be finished with 18 mm Granite with edges moulded on the exposed end.
- 15.7 All Brickwork shall be provided with Cement Mortar 1:4 (1Cement: 4 Coarse Sand). FPS Bricks of Clay / Fly Ash used shall be of Class – 105
- 15.8 Circular / Hexagonal M. S. Sheet Ceiling Fan Box shall be provided in the Ceiling with clamp of internal diameter 140 mm, 73 mm height, 3 mm thick Rim, top and bottom Lid of 1.5 mm M. S. Sheet. Lids shall be screwed in to M. S. Box by means of 3 mm round headed screws, clamps shall be made of 12 mm diameter M. S. Bar Bent to shape with overall length as 80 cm.
- 15.9 Powder Coated (minimum thickness 50 micron) Aluminium Work for Doors, Windows, Ventilators and Partitions shall be provided and fixed in building with extruded built up Standard Tubular and other Sections of approved make conforming to IS: 733 and IS : 1285, fixed with rawl plugs and screws or with fixing clips, or with expansion hold fasteners including necessary filling up of gaps at junctions at top, bottom and sides with required PVC / Neoprene felt etc and joined mechanically wherever required including Cleat Angle, Aluminium Snap Beading for glazing / panelling, C. P. Brass / Stainless Steel Screws including glazing and fittings as specified. All Doors except for Toilet and Kitchen shall have 100 mm, 6 Lever, C. P. Brass Mortise Latch, and Lock with a pair of Lever Handle. Sliding Door Bolt of

- ISI marked (300 x 16 mm) size shall be provided for Toilet, Kitchen, and Main Door of Control Room cum Administrative Buildings.
- 15.10 Cement based Water Proofing Treatment of Roofs, Balconies, Terraces etc shall be provided with average thickness of 120 mm and minimum thickness at Khurra as 65 mm and laid consisting of following operations: -
- a) A Slurry Coat of neat Cement using 2.75 kg / m² of Cement admixed with Proprietary Water Proofing Compounds conforming to IS: 2645 shall be applied and grouted over the RCC Slab including cleaning the surface before treatment.
 - b) Plain Cement Concrete 1:3:6 (1 Cement: 3 Fine Sand: 6 Burnt Brick Aggregate of 40 mm nominal size) admixed with Proprietary Water Proofing Compound conforming to IS: 2645 over 20 mm thick layer of Cement Mortar of Mix 1:5 (1 Cement: 5 Coarse Sand) admixed with Proprietary Water Proofing Compound conforming to IS: 2645 to required slope and treating similarly the adjoining walls upto 300 mm height including rounding of junctions of Walls and Slabs.
 - c) After two days of proper curing, a second coat of Cement Slurry admixed with Proprietary Water Proofing Compound conforming to IS: 2645 shall be applied.
 - d) The surface shall be finished with 20 mm thick joint less Cement Mortar of Mix 1:4 (1 Cement: 4 Course Sand) admixed with Proprietary Water Proofing Compound conforming to IS: 2645 and finally the surface shall be finished with trowel with neat Cement Slurry and making of 300 x 300 mm square.
 - e) The whole Terrace so finished shall be flooded with water for a minimum period of two weeks for curing and for final test. All above operations shall be done in order and as directed and specified by the Engineer - in – Charge.
- 15.11 C.I. Rain Water Pipes of 100 mm diameter shall be provided and fixed on the Wall Face conforming to relevant is code including jointing with Seal Ring conforming to IS: 5382 leaving 10 mm gap for thermal expansion single socket pipes including all fittings like bends, bat clamps gratings etc.
- 15.12 Pipe Clips of approved design shall be provided and fixed 100 mm CI Rain Water Pipes by means of 50 x 50 x 50 mm hard wood plugs, screwed with MS Screws of required length including cutting brick work and fixing in Cement Mortar 1:4 (1 Cement: 4 Coarse Sand) and making good the Wall etc.
- 15.13 Double Action Hydraulic Floor Spring of approved Brand and Manufacture IS: 6315 marked "Hardwyn" Make (Model 3000) or equivalent for Doors shall be provided and fixed at the following Door including cost of cutting floors as required, embedding in floors and cover plates with brass pivot and single piece MS Sheet Outer Box with slide plate etc as per the direction of Purchaser with Stainless Steel Cover Plate: -
- a) Main Entrance to Control Room Building
 - b) Station In-charge Room in Control Room
 - c) Conference Room

- d) Control Room
- 15.14 Plinth Protection 50 mm thick of Cement Concrete M25 (1 Cement: 1 Coarse Sand:2 Graded Stone Aggregate 20 mm nominal size) shall be laid over 75 mm bed of stone Ballast 40 mm nominal size, well rammed and consolidated and shall be grouted with fine sand including finishing the top smooth.
- 15.15 Coloured Vitreous China Pedestal Type Water Closet (European Type) shall be provided with Seat and Lid, 10 litres Low Level Vitreous China Flushing Cistern and CP Flush Bend with Fittings and CI Brackets, 40 mm Flush Bend, Overflow Arrangement and Mosquito Proof Coupling of including painting of Fittings and Brackets, cutting and making good the Walls and Floors wherever required.
- 15.16 Providing and fixing Coloured Wash Basin Counter Type of (630 x 450 mm size) and Flat Back Wash Basin of (550 x 400 mm size) with CI Brackets 15 mm CP Brass Pillar Taps, Close Hole Basin mixer 32 mm CP Brass Waste and Bottle Trap of standard pattern, including painting of Fittings and Brackets, cutting and making good the Walls wherever required.
- 15.17 All Urinals shall be Coloured Vitreous China Flat Back Half Stall Urinal of 580 x 380 x 350 mm with 10 liters PVC Automatic Flushing Cistern, Parryware / Hardware / Seabird / Orient (Coral) with fittings, standard size CP Brass Flush Pipe, Spreaders with Unions and Clamps (all in CP Brass) with Waste Fitting as per IS: 2556, CI Trap with Outlet Grating and other Couplings in CP Brass including painting of Fittings and Cutting and making good the Walls and Floors wherever required.
- 15.18 Following Fittings shall be provided in the Toilets: -
- a) Toilet Paper Roll Holder
 - b) Double Type Coat and Hat Hooks with flanges, fixed to Wall / Shutter, etc with necessary Screws, Washers and Plugs
 - c) CP Liquid Soap Holder of approved Make, fixed with each Wash Basin to the WALL with necessary CP Brackets, CP Screws, Washers, Plugs etc
 - d) 100 mm diameter Vitreous Chinaware Half Round Channel of approved Make fixed to correct grade, level, opening for Floor Trap below Urinals Set in CM 1:3 and pointed using White Cement etc.
 - e) CP Brass Bib Cock 15 mm nominal bore of approved quality conforming to IS: 8931.
 - f) CP Brass Angle Valve of 15 mm nominal bore provided and fixed in position for Basin and Cistern Points of approved quality conforming IS: 8931.
 - g) Best quality Marble Partition Slab provided and fixed in position for Urinals of size 610 x 1150 mm, 20 mm thick, polished on both sides and machine cut, exposed corners rounded etc.
 - h) Towel Rail of approved Make of 600 mm length, 25 mm diameter with a pair of Brackets or Flanges provided and fixed to Wall beside each wash Basin / Set of Wash Basin with necessary screws, plugs, etc.
 - i) 6 mm thick beveled edge Mirror 1,000 x 600 mm shall be provided and fixed

- mounted on 12 mm thick Water Proof Plywood backing and hardwood beading all round and Mirror fixed to the backing with 4 numbers of CP Cap, Screws and Washers, including fixing the Mirror to the Wall with necessary screws, plugs and washers etc, with each Wash Basin.
- 15.19 Stainless Steel AISI 304 (18 / 8) Kitchen Sink of 460 x 915 mm Bowl with depth of 178 mm with Drain Board shall be provided and fixed as per IS: 13983 with C. I. Brackets, and Stainless Steel Plug 40 mm with provision of 2 numbers CP Brass Long Body Bib Cock conforming to IS Standard and weighing not less than 650 gm for CP Bottle Trap etc including painting of fittings and brackets, cutting and making good the Wall.
- 15.20 GI Pipe Work for Internal and External Works: -
- a) All GI Types and Fittings shall conform to IS: 1239; Part - I and II for Medium Grade. All Accessories shall be ISI Marked.
 - b) All concealed GI Pipe shall be painted with Anticorrosive Bitumastic Paint including cutting of chases and making good the Wall.
 - c) All exposed GI Pipes and Fittings shall be painted with synthetic enamel paint of desired shade over a ready mixed priming coat, both of approved quality for new work.
 - d) Wherever GI Pipes are buried, the same shall be provided and laid in position including Trenching Sand Cushion and refilling, painted with anticorrosive bitumastic paint etc.
 - e) Gun Metal Ball Valve with Operating Levers, Non - Return Valves conforming to IS Specification shall be provided and fixed in position as per direction of Engineer - in – Charge.
- 15.21 Masonry Chamber for Sluice Valve shall be 600 x 600 mm size in Plan and depth 750 mm, or matching with the Site Condition inside with 50 Class Designation Brick Work in Cement Mortar 1:5 (1 Cement : 5 Fine Sand) with CI Surface Box 100 mm. As top Diameter, 160 mm as bottom Diameter and 180 mm deep (inside) with Chained Lid and RCC Top Slab 1:1:2 Mix M25 (1 Cement : 1 Coarse Sand: 2 Graded Stone Aggregate 20 mm nominal size) necessary excavation, foundation, Concrete 1:2:4 M15 (1 Cement : 2 Fine Sand : 4 graded Stone Aggregate 35 mm nominal size) and Inside Plastering with Cement Mortar 1:4 (1 Cement : 4 Coarse Sand), 12 mm thick finished with a floating coat of Neat Cement complete as per Standard Design with FPS Bricks of Class 75.
- 15.22 PVC Floor Traps of self-cleansing design shall be provided and fixed in position with outlet size of 75 mm diameter of approved make, including making connection with PVC Soil / Waste Pipes using Rubber Gaskets, embedding the Trap in 150 mm thick PCC 1:1½:3, providing and fixing of Top Tile and Strainer of CP or PVC on top of the Trap etc.
- 15.23 Square - Mouth SW Gully Trap Grade 'A' 100 x 100 mm size P type with FPS Bricks

- Class Designation 75 shall be provided and fixed complete with CI Grating Brick Masonry Chamber with Water Tight CI Cover with Frame of 300 x 300 mm size (inside) the weight of Cover to be not less than 4.5 kg and Frame to be not less than 2.70 kg as per standard design.
- 15.24 Brick Masonry Road Gully Chamber of 50 x 45 x 60 cm shall be provided with Brick with Cement Mortar 1:4 including 500 x 450 mm pre cast RCC Horizontal / Vertical Grating with frame complete.
- 15.25 Glazed Stoneware Pipes of 150 mm diameter Grade 'A' shall be provided, laid and jointed with stiff mixture of Cement Mortar in the proportion of 1:1 (1cement : 1 Fine Sand) including testing of joints etc. Complete.
- 15.26 Cement Concrete 1:5:10 (1 Cement: 5 Coarse Sand: 10 graded Stone Aggregate 40 mm nominal size) shall be provided and laid around S. W. Pipes including Bed Concrete.
- 15.27 Brick Masonry Manhole shall be constructed in Cement Mortar 1:4 (1 Cement: 4 Coarse Sand), RCC Top Slab with 1:1:2 Mix (1 Cement: 1 Coarse Sand: 2 graded Stone Aggregate 20 mm nominal size), Foundation Concrete 1:1:2 Mix (1Cement : 1 Coarse Sand: 2 graded Stone Aggregate 40 mm nominal size) inside Plastering 12 mm thick with cement Mortar 1:3 (1 Cement : 3 Coarse Sand) finished with floating coat of Neat Cement and making channels in Cement Concrete 1:1:2 (1 Cement: 1 Coarse Sand: 2 graded Stone Aggregate 20 mm nominal size) Finished with a floating coat of Neat Cement complete as per standard design.
- a) Inside size shall be 90 x 80 cm and 60 cm deep including CI Cover with Frame (Light Duty) 455 x 610 mm internal dimensions total weight of Cover and Frame shall not be less than 38 kg (weight of Cover 23 kg and weight of Frame 15 kg) and shall be constructed with F. P. S. / Fly Ash Bricks with Class Designation 75.
- b) Inside size shall be 120 x 90 cm and 90 cm or more deep including CI Cover with Frame (Medium Duty) 500 mm internal diameter total weight of Cover and Frame to be not less than 116 kg (weight of Cover 58 kg and weight of Frame 58 kg) with FPS Bricks Class Designation 75.
- 15.28 MS Foot of 20 x 20 mm Square Rests shall be provided and fixed in Manholes with 20 x 20 x 10 cm Cement Concrete Blocks 1:2:4 (1 Cement:2 Coarse Sand :4 graded Stone Aggregate 20 mm nominal size) as per standard design.
- 15.29 Steel Glazed Doors, Windows and Ventilators of standard Rolled Steel Sections shall be provided and fixed in Pump House and FFPH Building, jointed and welded with 15 x 3 mm lugs, 10 cm long, embedded in Cement Concrete Blocks 15 x 10 x 10 cm of 1:1½:3 (1 Cement 1½ Coarse Sand: 3 graded Stone Aggregate 20 mm nominal size) or with wooden plugs and screws or rawl plugs and screws or with fixing clips or with Bolts and Nuts as required, including providing and fixing of Glass Panes with Glazing Clips and Special Metal Sash Putty of approved Make complete

- including applying a priming coat of approved steel primer, necessary hinges or pivots as required to complete the work.
- 15.30 Pressed Steel Door Frames manufactured from commercial Mild Steel Sheet of 1.25 mm thickness shall be provided and fixed in Pump House and FFPH Building including hinges jamb, lock jamb, bead and if required angle threshold of Mild Steel Angle of Section 50 x 25 mm, or Base Ties of 1.25 mm Pressed Mild Steel welded or rigidly mixed together by mechanical means, adjustable lugs with split end tail to each jamb including steel butt hinges 2.5 mm thick with mortar guards, lock strike - plate and shock absorbers as specified and applying a coat of approved steel primer after pre - treatment of the surface as directed by Engineer - in - Charge.
- 15.31 Galvanized iron 0.63 mm thick Corrugated Sheets Roofing shall be provided and fixed with G, I, J or L Hooks, Bolts and Nuts 8 mm diameter G. I. Plain and Bitumen Washers complete excluding the cost of purlins, rafters and trusses for Water Tank.
- 15.32 Water Closet Squatting Pan (Indian Type W. C. Pan) (White Vitreous China Orissa Pattern W. C. Pan of size 580 x 440 mm with integral type Foot Rests) shall be Provided with 100 mm Sand Cast Iron P or S Trap. Ten (10) litres low Level White PVC Flushing Cistern with Manually Controlled Device (Handle Lever) conforming to IS: 7231, with all Fittings and Fixtures complete including cutting and making good the Walls and Floors wherever required.
- 15.33 Coloured Vitreous China Pedestal Type Water Closet (European Type) shall be provided with Seat and Lid, 10 liter Low Level White Vitreous China Flushing Cistern and CP Flush Bend with Fittings and CI Brackets, 40 mm Flush Bend, Overflow Arrangement with specials of standard Make and Mosquito Proof Coupling of approved municipal design complete including painting of Fittings and Brackets, cutting and making good the Walls and Floors wherever required.
- 15.34 Coloured Vitreous China Flat Back Half Stall Urinal of size 580 x 380 x 350 mm shall be provided with 5 liter PVC Automatic Flushing Cistern with Fittings, standard size CP Brass Flush Pipe, Spreaders with Unions and Clamps (all in CP Brass) with Waste Fitting as per IS: 2556, CI Trap with Outlet Grating and other Couplings in CP Brass including painting of Fittings and cutting and making good the Walls and Floors wherever required.
- 15.35 Wash Basin Counter Type (630 x 450 mm) and Flat Back Wash Basin (550 x 400 mm) shall be provided with CI Brackets, 15 mm CP Brass Pillar Taps, Close Hole Basin Mixer 32 mm, CP Brass Waste and Bottle Trap of standard pattern, including painting of Fittings and Brackets, cutting and making good the Walls wherever required.
- 15.36 All doors except Toilet and Kitchen shall have 100 mm, 6 Liver Mortice Lock and a pair of Lever Handles with necessary Screws complete etc.
- 15.37 Aluminium Sliding Door with ISI marked Anodized Transparent and dyed to required

- colour or shade shall be provided at Main Entry Door, Toilets, and Kitchen.
- 15.38 Pelmet shall be provided 18 mm thick, 150 mm wide of Coir Veneer Board ISI marked including Top Cover of 6 mm of Coir Veneer Board and Lipping Nickel Plated MS Pipe 20 mm diameter (Heavy Type) Curtain Rod with Nickel Plated (including fixing with 25 x 3 mm MS Flat, 10 cm long and Rawl Plug all complete.
- 15.39 Cement Jaali of (1:2:4) (1 Cement: 2 Coarse Sand: 4 coarse Aggregate) 50 mm thick, shall be reinforced with 1.6 mm diameter with Mild Steel Wire including centring and shuttering cleaning fixing and furnishing with Cement Mortar 1:3).
- 15.40 Providing and Fixing 15mm thick approximately 600 x 600 mm Mineral Fibre Board Panel along with False Ceiling and making cut outs for Electrical Fixtures, AC Diffusers, Open able Access etc complete with Silhouette Profile System with 15 mm wide Flange incorporating 6 mm Central Recess White / Black Main Runners at 1,200 mm centre - centre and not greater than 600 mm from the adjacent wall. The Cross Tees shall be provided to make a module of approximately 600 mm x 600 mm by fitting 600 mm long Cross Tees centrally placed between 1200 mm long Cross Tees Cross Tees also have 15 mm wide flange incorporating 6 mm central recess white / black. The Module formed above shall be anchored to the Slab with Channels or Angles, Suspenders as per Manufacturer's Specifications. It shall be provided in all the AC Area of Control Room.
- 15.41 The Tiles / Paver Blocks shall be made of White Cement in order to accentuate the vibrancy of colours and to ensure the increased natural sheen of the Tile / Block with regular use and maintenance with an aggregate mix not leaner than 1:3 and shall be free from the use of undesirable substitutes such as slag / red mud. Moreover the Pigments used in each and every Tile / Block shall be imported Bayer Pigments which have a higher colour consistency and fade resistance. Moreover, the Pigments shall also have higher UV Stability and should not fade / crack in the exterior weather conditions.
- 15.42 The Bidder shall ensure that the material is brought on Site in a packed condition with minimal / no damages or breakages in transit. The thickness of Floor Tiles shall be 22 mm and that of Flexi Paver Block shall be 60 mm.
- 15.43 The Concrete Tiles and Flexi Pavers shall be laid over Cement Mortar 1:4 (1 Cement 4 Coarse Sand) over an average thickness of 25 mm The Base shall be 100 mm thick PCC 1:5:10. The jointing shall be done with white cement mixed with pigment matching to the Tiles.

16.0 INTERFACING:

The proper coordination and execution of all Interfacing Civil Works activities like Fixing of Conduits in Roofs / Walls / Floors, Fixing of Foundation Bolts, Fixing of Lighting Fixtures, Fixing of Supports / Embedment, provision of cut - outs etc shall be the sole responsibility of the Bidder. He shall plan all such activities in advance and

execute in such a manner that interfacing activities do not become bottlenecks and dismantling breakage etc is reduced to minimum.

17.0 WATER SUPPLY:

A Scheme shall be prepared by the Bidder indicating the Layout and details of Water Supply which shall be got approved from the Purchaser before actual start of work by submitting Water Test Fitness for Drinking Purpose.

Purchaser will provide water at one location within the Substation and further distribution shall be done by the Bidder.

18.0 SEWERAGE SYSTEM:

- (i) Sewerage System shall be provided for Control Room Cum GIS Building.
- (ii) The Bidder shall construct Septic Tank and Soak Pit suitable for 50 users.
- (iii) The System shall be designed as per relevant IS Codes.
- (iv) Sewerage System includes all Internal and External Heavy Cast Iron and GI Pipe Fittings Accessories.

19.0 STATUTORY RULES:

- 19.1 Bidder shall comply with all the applicable Statutory Rules pertaining to Factories Act (as applicable for the State) Fire Safety Rules of Tariff Advisory Committee, Water Act for Pollution Control etc.
- 19.2 Provisions for Fire Proof Doors, Number of Staircases, Fire Separation Wall, Plastering on Structural Members (in Fire Prone Areas) etc shall be made according to the recommendations of Tariff Advisory Committee.
- 19.3 Statutory Clearance and Norms of State Pollution Control Board shall be followed as per Water Act for effluent quality from Plant.
- 19.4 Requirement of Sulphate Resistant Cement (SRC) for Sub Structural Works shall be decided in accordance with the Indian Standards based on the findings of the detailed Soil Investigation to be carried out by the Bidder.
- 19.5 Foundation System adopted by Bidder shall ensure that relative settlement and other criteria shall be as per provisions in IS: 1904 and other Indian Standards.
- 19.6 All Water Retaining Structures designed as Untracked Section shall also be Tested for Water Tightness at Full Water Level in accordance with Clause No. 10 of IS: 3370 (Part - I).
- 19.7 Construction Joints as per IS: 456 at the following Locations shall be provided: -
 - (i) At the Meeting Points of the Columns and the Raft
 - (ii) At the Point of Contra Flexure in the Columns
 Additional Reinforcement and Shear Keys shall be provided at the Construction

Joints

- 19.8 All Underground Concrete Structures like Basements, Pumps Houses, Water Retaining Structures etc shall have Plasticizer Cum Water Proofing Cement Additive conforming of IS: 9103. In addition, limit on permeability as given in IS: 2645 shall also be met with. The Concrete Surface of these Structures in contact with Earth shall also be provided with two Coats of Bituminous Painting for Water / Damp Proofing. In case of Water Leakage in the above Structures, Injection Method shall be applied for repairing the leakage.

20.0 MODE OF MEASUREMENT:

20.1 EARTHWORK:

This shall include Excavation in all kinds of Soil including Rock, all Leads, and Lifts including Back Filling, Compacting, Dewatering (if required), and Disposal of Surplus Earth to a suitable location. The Quantity of Excavation for Foundations of Towers, Equipment Structures, all Transformers, Firewall, Cable Trenches, Water Tank, Reactors, Buildings, and underground Water Tanks, Covered Car Parking shall only be measured. The Quantity of Excavation for Roads, Rail Cum Road, Drains, Rainwater Harvesting, Septic Tank, Soak Pit, External Water Supply System, Site Surfacing, Chain Link Fencing (including Gate) shall not be measured separately and shall be deemed to be included in the Composite Rates quoted by the Bidder for the respective Works. All other Excavation required for the completion of the Work including Fixing of Lamp Posts, Plinth Protection, Flooring, Sewerage System, Manholes, Pipes, Earthmat etc shall also not be paid for. The Measurement of Excavation of all Concrete Works shall be made considering Dimension of the Pit Leaving 150 mm gap around the Base Pad (Lean Concrete) or actually Excavated Pit, whichever is less. The Quantity shall be measured in **cubic meters**.

20.2 PCC:

Providing and Laying Plain Cement Concrete of all Types and at all Locations including all Leads and Lifts. The Quantity shall be measured in **cubic meters**.

However the PCC required for the completion of the Work including Hold Fast of Doors / Windows / Rolling Shutters, Fixing of Plumbing Pipes, Bedding Concrete for Sewer Lines, Embedment of Electrical Conduits etc shall not be measured and deemed included in the Composite Rates Quoted by the Bidder for Respective Works. Water proofing compound /Admixture, wherever specified shall be added without any extra cost.

20.3 RCC:

Measurement of Reinforced Cement Concrete at all Locations shall be made and shall include all Leads, Lifts, Formwork, Grouting of Pockets and Underpinning, (but shall Exclude Reinforcement). This shall also include pre – cast RCC Work and addition

of Water Proofing Compound wherever required for which no additional payment shall be made. The Quantity shall be measured in **cubic meters**. No Deduction shall be made for Volume occupied by Reinforcement / Inserts / Sleeves and for openings having cross – sectional area up to 0.1 sq. M.

20.4 STEEL REINFORCEMENT:

Reinforcement shall be measured in Length (actual) including Hooks, if any, separately for Different Diameters as actually used in Work, excluding Overlaps. From the Length so measured, the Weight of Reinforcement shall be calculated in **MT** based on Sectional Weights as adopted by Indian Standards. Wastage, Overlaps, Couplings, Welded Joints, Spacer Bars, Chairs, Stays, Hangers and Annealed Steel Wire or other methods for Binding and placing shall not be measured and cost of these Items shall be deemed to be included in the Rates for Reinforcement.

20.5 STONE FILLING:

Measurement of Stone (30 mm nominal size) for Transformer Foundations shall be Made as per actual Volume of the Space to be filled in the Transformer Foundation. This shall be measured in **cubic meters**.

20.6 BUILDING AREAS:

220kV Control room building shall be Single Storey building.

220kV GIS building shall be single storey building, height depends upon the GIS Equipment clearance. Car parking area shall be 80 sqmm and provision for 3 nos. of Four Wheelers and 2 nos. of two wheelers. Security post area shall be 12 sqmm.

20.7 STORE SHED (FOR KEEPING MANDATORY SPARES) & CAR PARKING:

One no store shed of size 15X15 meter having brick walls and plastering and

A Site Store of size (15 x 15) shall be constructed as per Design and drawing developed by the contractor. The Building specification shall be RCC frame with brick work 230 thick. With MS Stress roof covered with pre painted MS profile sheet as per DSR for thickness 0.5 mm. MS frame rolling shutter of size 4 Mtr. Width 4.5 Mtr. Wide and 5 Mtr. Height shall be also provided. 2 Nos. MS frame windows with 10 mm Sq. Bar Grills and 5.5 mm thick glass glazed ventilators (4 Nos.) shall be also provided 2 Nos. flush doors shutters (35 mm) with commercial ply, duly painted shall be provided.

20.7.1 PARKING SHED:-

There shall be one no vehicle parking shed inside the sub-station area. The size of the parking area shall be 15mtrs X 15 mtrs, out of the entire area there shall be provision of shed for 5 mtrs X 15 mtrs and rest of the area shall be without shed.

20.8 SECURITY HUT:

RCC type security shed near the main gate to be provided. The shed shall be provided with telephone, electrical lighting and ceiling fan facilities. There shall be provision of gate lights. The size of the security hut shall be 5mtrsX3.5mtrsX3.5mtr (Length X width X Height).And Adequate no of MS doors and windows are also to be provided. Necessary paintings as per

standard are also to be done.

20.9 FIRE FIGHTING PUMP HOUSE: GENERAL

The scope includes design, engineering and construction, including anti-termite treatment, plinth protection, DPC, peripheral drains, fire-fighting, electrification etc. of fire fighting pump house building. The fire fighting pump house building shall be essentially single storied reinforced cement concrete (RCC) framed Building. The building auxiliary services like internal electrification, fire protection systems shall be designed in accordance with the requirements as specified in relevant section of technical Specification. The design and layout of foundation of various pumps and cable trenches inside building shall be prepared by the contractor as per requirement of proposed fire fighting system.

AREA REQUIREMENTS

Dimensions of the Building shall be decided by the bidder depending upon the requirement. The approximate size of building is 8 m X 5 m X 4.5 m high. The height of building shall be measured from finished floor level to top of roof slab.

DESIGN CRITERIA

The Building shall be designed:

1. To the requirements of the relevant /Indian standards/ equivalent International standards quoted therein, and as specified in this specification.
2. for the specified climatic and loading conditions.
3. To adequately suit the requirements of the pumps and firefighting system contained in the buildings and in all respects to be compatible with the intended use and occupancy with a functional and economical space arrangement.
4. To be aesthetically pleasing. Different buildings shall show a uniformity and consistency in architectural design, as far as possible.
5. To allow for easy access to the equipment's as well as maintenance of the equipment's.
6. G.I. ladder with cage shall be provided for access to the roof.
7. With, wherever required, fire retarding materials for walls, ceilings doors etc., which would prevent supporting or spreading of fire and shall be decided by the bidder.
8. Suitable Expansion joints, wherever required, shall be provided as per Codal Provisions.
 9. All the members of the buildings frame shall be designed for the worst combination of Loads as per relevant International standards/Indian Standards.
 10. Permissible stresses for different load combinations shall be taken as per relevant International standards/Indian Standards.
 11. Seismic analysis of the building for Earthquake forces shall be carried out as per relevant International standards/Indian Standards (IS 1893).

DESIGN LOADS

1. Building structure shall be designed for the most critical combinations of dead loads, super-imposed loads, equipment loads, wind loads, seismic loads etc. Any other incidental load, if anticipated, shall be duly accounted for in the design, and shall be clearly mentioned by the bidder.
2. Dead loads shall include the weight of structures complete with finishes, fixtures and partitions, and shall be taken as per relevant International standards/Indian Standards.
3. Super-imposed loads in different areas shall include live loads, cable trays, and small pipe racks/hangers, piping system and erection, operation and maintenance loads wherever these loads are expected.
 - a) Non-accessible Roof – 0.75 kN/m².
 - b) Accessible Roof – 1.50 kN/m²
4. Wind loads shall be calculated as per relevant International standards/Indian Standards. The Factors affecting the wind speed shall be taken based on the site conditions.
5. Earthquake loads shall be calculated as per relevant International standards/Indian Standards.
6. Wind forces and Seismic forces shall not be considered to act simultaneously.
7. All the load combinations to create worst combinations of loads shall be as per relevant International standards/Indian Standards.
8. Floors shall be designed to carry loads imposed by Pumps, cables, piping, movement of maintenance trucks (if required) and any other load associated with the building. In general, floors shall be designed for live loads as per relevant International standards/Indian Standards. Cable and piping loads shall also be considered in addition to the live loads for floors where these loads are expected.

FLOORS, WALLS & ROOFS

The floor shall be constructed with 52 mm thick cement concrete finished with iron saw dust hardener topping. 150 mm thick base plain cement concrete layer, 100 mm thick compacted local sand filling and 200 mm thick hard core of stone ballast with interstices filled with local sand shall be laid below cement concrete flooring top. The earth filling below floor shall be well rammed.

PLASTERING

External surfaces of building shall have 18 mm thick plaster in two layers, with the under layer 12mm thick 1:5 cement sand (coarse) plaster and the top layer 6 mm thick 1:6 cement sand (coarse) plaster. Inside wall surfaces shall have 12/15 mm thick 1:6 cement sand (coarse) plaster. Rough surfaces shall have 15mm and smooth surface shall have 12 mm thick cement sand plaster. Ceiling shall be plastered with 6 mm thick cement sand plaster (1 Cement : 3 Sand).

EXTERNAL PAINTING

External surfaces of the Building shall be painted with acrylic exterior flat paint as per manufacturer's specification and approval of Employer.

DOORS, WINDOWS AND VENTILATORS

The schedule of doors, roller shutter, windows and ventilators of the Building shall be of steel as per relevant International standards/Indian Standards. Rolling Steel shutters shall be provided as per the layout and requirements of the building. Main entrance door to the Building shall be MS door frame with M.S. sheet double shutter. Windows and ventilators shall be of steel made of hot rolled sections windows and ventilators shall be provided with 5.5 mm thick glazing.

PLINTH PROTECTION

750 mm wide plinth protection all-around the building shall be provided. Plinth protection shall comprise of 50 mm thick PCC (1:2:4) laid over 75 mm thick well compacted stone aggregates with interstices filled with local sand including smooth finishing top.

PARAPET

230 mm thick and 500 mm high brick parapet shall be provided. The parapet shall be plastered with cement sand plaster (1:6).

BUILDING STORM WATER DRAINAGE

1. The building design shall provide for the collection of storm water from the roof. This water shall be drained to the main drainage system of the Sub-station.
2. Cast Iron Rainwater down comer's pipes conforming to relevant International standards/Indian Standards with water tight lead joints or medium class galvanized mild steel pipes conforms to relevant International standards/Indian Standards shall be provided to drain off the rain water from the roofs. These pipes shall be suitably concealed with masonry work or cement concrete or cladding material.
3. Suitable arrangements for draining out water collected from equipment blow downs, leakages, floor washings, fire fighting etc. shall be provided, if found necessary.

DETAILS OF ROOF

Roof of the Building shall consist of Cast-in-situ RCC slab treated with a water proofing system which shall be an integral cement-based treatment conforming to relevant International standards/Indian Standards. The water proofing treatment shall be of following operations:

- (a) Applying and grouting a slurry coat of neat cement using 2.75 kg/m² of cement admixed with proprietary water proofing compounds conforming to relevant International standards/Indian Standards over the RCC slab including cleaning the surface before treatment.
- (b) Laying cement concrete using broken stones 25mm to 100mm size with 50% of cement mortar 1:5 (1 cement: 5 coarse sand) admixed with proprietary water proofing compound

conforming to relevant International standards/Indian Standards over 20mm thick layer of cement mortar of min 1:5 (Cement: 5 coarse sand) admixed with proprietary water proofing compound conforming to relevant International standards/Indian Standards to required slope and treating similarly the adjoining walls up to 300mm height including rounding of junctions of walls and slabs.

- (c) After two days of proper curing applying a second coat of cement slurry admixed with proprietary water proofing compound conforming to relevant Indian standard codes (I S Codes) / equivalent International Standards.
- (d) Finishing the surface with 20mm thick joint less cement mortar of mix 1:4 (1 cement: 4 coarse sand) admixed with proprietary water proofing compound conforming to relevant International standards/Indian Standards and finally finishing the surface with trowel with neat cement slurry and making of 300 x 300 mm square.
- (e) The whole terrace so finished shall be flooded with water for a minimum period of two weeks for curing and for final test. All above operations to be done in order and as directed and specified by the Executive Engineer In charge.
- (f) Average thickness of water proofing shall be 120 mm and minimum thickness at khurra shall be 65 mm.

The detailed finish schedule for Fire Fighting Pump House Building is given below:

Table- 2 : DETAILED FINISH SCHEDULE

S.	LOCATION	FLOORING & SKIRTING 150 MM HIGH	WALL (Internal)	CEILING	ROLLER SHUTTER, DOOR, WINDOWS & VENTILATOR
1.	Firefighting Pumphouse	62mm thick cement concrete flooring with metallic hardener topping .skirting shall be of cement sand plaster.	Oil bound washable distemper on masonry portion.	As per Manufacturer details.	Windows/ ventilator shall be hot rolled steel section with 5.5mm thick glazing. Entry door shall be of M.S. Sheet double shutter and rolling

					shutter shall be of steel.
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ELECTRIFICATION

Electrification shall be executed as per details specified elsewhere in the technical specification. All details shall be as per relevant Indian standard codes (I S Codes)/ equivalent International Standards.

Fire Fighting Water Tank:

Reinforced cement concrete water tank with two compartments each of size 9.31 m X 9.31 m and capacity of 317 Cubic Meter shall be constructed. A sump of size 2.5 m X 2.5 m x 0.5 m deep shall be provided at one corner in each compartment. Finished floor level of water tank shall be about 200 mm above finished ground level of switch yard. Base slab of water tank shall rest on 75 mm thick plain cement concrete (1:3:6) laid over 800 mm thick well compacted stone packing (Stone Size from 25 mm to 150 mm) with interstices filled with local sand. The roof of Water tank shall be of Asbestos Corrugated sheet. The sheet shall be supported on suitable steel purlins etc. Suitable gutter shall be provided to drain off rain water.

1. A steel door of size 900 mm X 1850 mm with single shutter made of hot rolled steel section and MS steel door frame shall be provided at about (+) 4.5 m level for access inside water tank.
 2. Suitable MS rungs of 20 mm diameter rod @ 300 mm centre to centre staggered on both faces (External and internal) of wall at suitable location shall be provided to act as ladder.
 3. Integral water proofing compound of reputed brand shall be added to the concrete and plaster of water tank. Quantity of compound shall be as per manufacturer's recommendation.
 4. All inserts, nozzles, pipe sleeves etc. shall be provided during concreting at suitable locations as per firefighting system. The size is to be decided by the contractor to meet the requirement.
 5. Inside surfaces of water tank shall be plastered with cement sand plaster (1 Cement: 6 sand).
 6. The outer surface of water tank shall be painted with the paint matching with Firefighting pump house building.
 7. P.V.C. water stopper shall be provided at all construction joints of water tank.
- The design of water tank shall be carried out as per relevant Indian standard codes (I S Codes)/ equivalent International Standards.

20.10 STATION TRANSFORMER FOUNDATION:

250KVA Station transformers founded on RCC foundation with rails on the top so as to transport the transformers from their respected locations during maintenance the foundation arrangement shall include oil soak pits and RCC paving of minimum thickness

100mm laid over laterite base of 230mm consolidation thickness shall be provided for the entire transformer area.

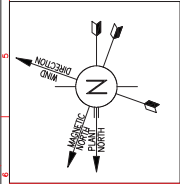
20.11 **DG FOUNDATION:**

250KVA DG foundation shall be RCC base slab provide on the bottom below Laying Plain Cement Concrete 75mm thick and above the ground level minimum 150mm .The design shall be based on working stress method

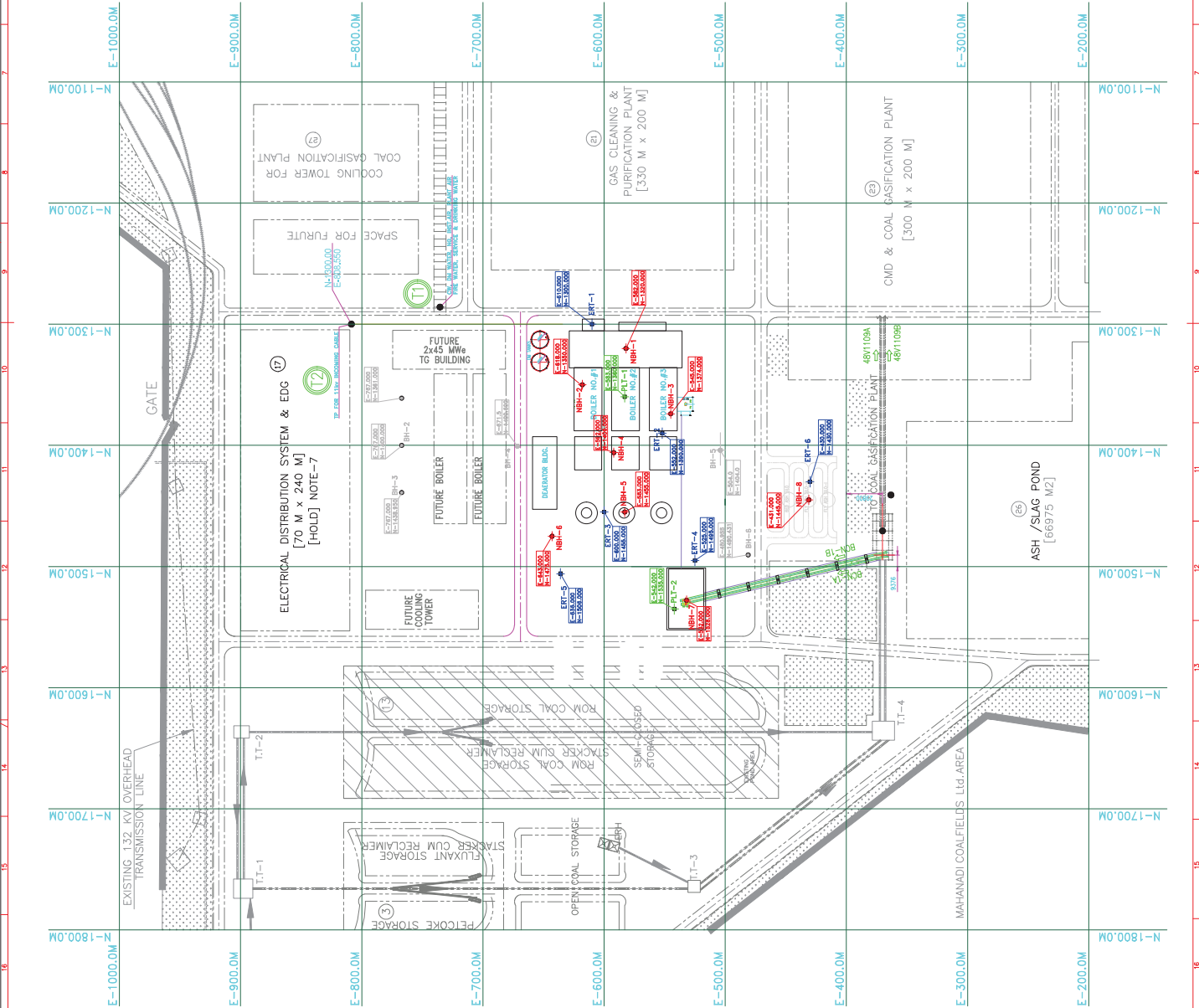
20.12 **MISCELLANEOUS STRUCTURAL STEEL:**

Measurement for Supply, Fabrication, Transportation, and Erection of all Miscellaneous Structural Steel Work for Mono Rails (RS Joists), Rails for Transformers / Reactors, Trusses, Frame Work, Purlins, Gratings, Steel Tubes, Built Up Sections along with all other Steel Fittings and Fixtures, Inserts and Embedment in Concrete shall be made as per approved drawings. The Unit Rate for this Item shall be inclusive of cutting, grinding, drilling, bolting, welding, pre – heating of the welded joints, applying a priming coat of steel primer and anti-corrosive bitumastic paint / synthetic enamel paint etc (wherever specified), setting of all types of embedment in concrete, etc. Steel required for Foundation Bolts, Nuts and Bolt, Doors, Windows, Ventilators, Louvers, Rolling Shutters, Chain Link Fencing, Gratings in Drains, Soil Pipes, Plumbing Pipes, Floor Traps, Embedment's required for Rainwater Harvesting, Septic Tank, Soak Pit, Roof Truss and Purlins required for Fire Water Tank, etc shall not be considered for payment and measurements. Quantity shall be measured in **MT**.

Part-28.1
Soil Investigation Report of TFL Plant
(For Reference Only)



- LEGEND:**
- NBH-NEW BORE HOLE TO BE EXECUTED (NBH-1 TO NBH-8)
 - ERT-NEW ERT TO BE EXECUTED (ERT-1 TO ERT-5)
 - PLT-PLATE LOAD TEST (PLT-1 & PLT-2)
 - BH-OLD BORE HOLE (ONLY FOR INFORMATION)



DETAILS OF FIELD OPERATION

DETAILS OF BOREHOLES (NBH):

NBH NO.	Plant Co-Ordinates		Existing Ground Level in (m)	Termination Depth in (m)	Ground Water Level (m)
	EASTING	NORTHING			
01	582.00	1320.00	98.100	15.00	3.40
02	618.00	1350.00	98.950	10.00	3.60
03	545.00	1374.00	98.050	10.00	3.55
04	592.00	1406.00	97.240	10.00	0.90
05	583.00	1455.00	97.200	10.00	1.30
06	643.00	1475.00	97.100	10.00	0.90
07	532.00	1528.00	97.215	10.00	2.40
08	431.00	1445.00	99.600	10.00	3.50

DETAILS OF TRAILPIT (FOR PLT):

TP NO.	Plant Co-Ordinates		Existing Ground Level in (m)
	EASTING	NORTHING	
PLT-01	583.00	1360.00	98.070
PLT-02	542.00	1535.00	97.050

DETAILS OF DYNAMIC CONE PENETRATION TEST:

DCPT NO.	Plant Co-Ordinates		Existing Ground Level in (m)
	EASTING	NORTHING	
01	575.00	1403.00	97.050
02	643.00	1403.00	98.100

DETAILS OF ERT:

ERT NO.	Plant Co-Ordinates	
	EASTING	NORTHING
01	610.00	1300.00
02	552.00	1390.00
03	600.00	1455.00
04	525.00	1495.00
05	636.00	1506.00
06	430.00	1430.00

ANALYSIS OF STRATUM

NBH No: 01

N Bore Hole 01 was driven up to a depth of 15.00M. The sub-soil of the bore hole is given in Lithological form and summarized as follows:

Stratum – I

The strata below an average depth of 0.00m to 5.50m consist of Clayey sand. The 'N' value varies from 79 to 95. The stratum is Hard to Very dense.

Stratum-II

The strata below an average depth of 5.50m to 15.00m consist of Soft Disintegrated Rock. The 'N' value is greater than 100. The stratum is Very dense.

NBH No: 02

N Bore Hole 02 was driven up to a depth of 10.00M. The sub-soil of the bore hole is given in Lithological form and summarized as follows:

Stratum – I

The strata below an average depth of 0.00m to 6.00m consist of Clayey sand. The 'N' value varies from 54 to 92. The stratum is Hard to Very dense.

Stratum-II

The strata below an average depth of 6.00m to 10.00m consist of Soft Disintegrated Rock. The 'N' value is greater than 100. The stratum is Very dense.

NBH No: 03

N Bore Hole 03 was driven up to a depth of 10.00M. The sub-soil of the bore hole is given in Lithological form and summarized as follows:

Stratum – I

The strata below an average depth of 0.00m to 4.50m consist of Clayey sand. The 'N' value varies from 44 to 89. The stratum is Hard to Very dense.

Stratum-II

The strata below an average depth of 4.50m to 10.00m consist of Soft Disintegrated Rock. The 'N' value is greater than 100. The stratum is Very dense.

NBH No: 04

N Bore Hole 04 was driven up to a depth of 10.00M. The sub-soil of the bore hole is given in Lithological form and summarized as follows:

Stratum – I

The strata below an average depth of 0.00m to 4.50m consist of Clayey sand. The 'N' value varies from 48 to 102. The stratum is Hard to Very dense.

Stratum-II

The strata below an average depth of 4.50m to 10.00m consist of Soft Disintegrated Rock. The 'N' value is greater than 100. The stratum is Very dense.

NBH No: 05

N Bore Hole 05 was driven up to a depth of 10.00M.The sub-soil of the bore hole is given in Lithological form and summarized as follows:

Stratum – I

The strata below an average depth of 0.00m to 3.00m consist of Clayey sand. The ‘N’ value is 60.The stratum is Hard to Very dense.

Stratum-II

The strata below an average depth of 3.00m to 10.00m consist of Soft Disintegrated Rock. The ‘N’ value is greater than 100.The stratum is Very dense.

NBH No: 06

N Bore Hole 06 was driven up to a depth of 10.00M.The sub-soil of the bore hole is given in Lithological form and summarized as follows:

Stratum – I

The strata below an average depth of 0.00m to 3.00m consist of Clayey sand. The ‘N’ value is 48.The stratum is Hard to Dense.

Stratum-II

The strata below an average depth of 3.00m to 10.00m consist of Soft Disintegrated Rock. The ‘N’ value is greater than 100.The stratum is Very dense.

NBH No: 07

N Bore Hole 07 was driven up to a depth of 10.00M.The sub-soil of the bore hole is given in Lithological form and summarized as follows:

Stratum – I

The strata below an average depth of 0.00m to 1.50m consist of Clayey sand. The ‘N’ value is greater than 100 .The stratum is Hard to Very dense.

Stratum-II

The strata below an average depth of 1.50m to 10.00m consist of Soft Disintegrated Rock. The ‘N’ value is greater than 100.The stratum is Very dense.

NBH No: 08

N Bore Hole 08 was driven up to a depth of 10.00M.The sub-soil of the bore hole is given in Lithological form and summarized as follows:

Stratum – I

The strata below an average depth of 0.00m to 5.50m consist of Clayey sand. The ‘N’ value varies from 44 to greater than 100 .The stratum is Hard to Very dense.

Stratum-II

The strata below an average depth of 5.50m to 10.00m consist of Soft Disintegrated Rock. The ‘N’ value is greater than 100.The stratum is Very dense.

The Sub-stratification and respective index and engineering properties have been described. Based on the above, the design parameters are summarized for foundation analysis of various areas in the proceeding sections.

DESIGN PARAMETER

NBH-01

Stratum No.	Stratum Description	Depth of Stratum		Thickness of Stratum (m)	Ground Water Table (m)	' N ' Value	Corrected ' N ' Value	Unit Weight		Natural Moisture content (%)	Shear Parameters		Atterberg's Limit	
		Start Depth	End Depth					Bulk Density	Dry Density		C (t/m ²)	Ø (°)	LL	PL
1	Clayey sand	0.00	5.50	5.50	3.40	79-95	47-55	1.89	1.57	21	0.90	26	32	21
2	Soft Disintegrated Rock	5.50	15.00	9.50		100	57.50	1.92	1.64	17	0.00	31	-	-

NBH-02

Stratum No.	Stratum Description	Depth of Stratum		Thickness of Stratum (m)	Ground water Table (m)	' N ' Value	Corrected ' N ' Value	Unit Weight		Natural Moisture content (%)	Shear Parameters		Atterberg's Limit	
		Start Depth	End Depth					Bulk Density	Dry Density		C (t/m ²)	Ø (°)	LL	PL
1	Clayey sand	0.0	6.00	6.00	3.60	54-92	34.50 - 53.50	1.87	1.55	21	1.00	24	32	21
2	Soft Disintegrated Rock	6.00	10.00	4.00		100	57.50	1.93	1.64	18	0.00	32	-	-

NBH-03

Stratum No.	Stratum Description	Depth of Stratum		Thickness of Stratum (m)	Ground Water Table (m)	' N ' Value	Corrected ' N ' Value	Unit Weight		Natural Moisture content (%)	Shear Parameters		Atterberg's Limit	
		Start Depth	End Depth					Bulk Density	Dry Density		C (t/m ²)	Ø (°)	LL	PL
1	Clayey sand	0.0	4.50	4.50	3.55	44-89	29.50 - 52.00	1.88	1.57	20	1.00	24	33	22
2	Soft Disintegrated Rock	4.50	10.00	5.50		100	57.50	1.94	1.66	17	0.00	33	-	-

NBH-04

Stratum No.	Stratum Description	Depth of Stratum		Thickness of Stratum (m)	Ground Water Table (m)	' N ' Value	Corrected ' N ' Value	Unit Weight		Natural Moisture content (%)	Shear Parameters		Atterberg's Limit	
		Start Depth	End Depth					Bulk Density	Dry Density		C (t/m ²)	Ø (°)	LL	PL
1	Clayey sand	0.0	4.50	4.50	0.90	48-100	31.50 -	1.89	1.55	22	0.90	25	33	22
2	Soft Disintegrated Rock	4.50	10.00	5.50		100	57.50	1.92	1.66	16	0.00	32	-	-

NBH-05

Stratum No.	Stratum Description	Depth of Stratum		Thickness of Stratum (m)	Ground Water Table (m)	' N ' Value	Corrected ' N ' Value	Unit Weight		Natural Moisture content (%)	Shear Parameters		Atterberg's Limit	
		Start Depth	End Depth					Bulk Density	Dry Density		C (t/m ²)	Ø (°)	LL	PL
1	Clayey sand	0.00	3.00	3.00	1.30	60	37.50	1.88	1.55	21	1.00	25	31	20
2	Soft Disintegrated Rock	3.00	10.00	7.00		100	57.50	1.94	1.66	17	0.00	33	-	-

NBH-06

Stratum No.	Stratum Description	Depth of Stratum		Thickness of Stratum (m)	Ground Water Table (m)	' N ' Value	Corrected ' N ' Value	Unit Weight		Natural Moisture content (%)	Shear Parameters		Atterberg's Limit	
		Start Depth	End Depth					Bulk Density	Dry Density		C (t/m ²)	Ø (°)	LL	PL
1	Clayey sand	0.00	3.00	3.00	0.90	48	31.50	1.89	1.58	20	1.10	23	32	20
2	Soft Disintegrated Rock	3.00	10.00	7.00		100	57.50	1.94	1.66	17	0.00	33	-	-

NBH-07

Stratum No.	Stratum Description	Depth of Stratum		Thickness of Stratum (m)	Ground Water Table (m)	' N ' Value	Corrected ' N ' Value	Unit Weight		Natural Moisture content (%)	Shear Parameters		Atterberg's Limit	
		Start Depth	End Depth					Bulk Density	Dry Density		C (t/m ²)	Ø (°)	LL	PL
1	Clayey sand	0.00	1.50	1.50	2.40	100	57.50	1.89	1.56	21	1.00	24	-	-
2	Soft Disintegrated Rock	1.50	10.00	8.50		-	-	1.93	1.67	16	0.00	32	-	-

NBH-08

Stratum No.	Stratum Description	Depth of Stratum		Thickness of Stratum (m)	Ground Water Table (m)	' N ' Value	Corrected ' N ' Value	Unit Weight		Natural Moisture content (%)	Shear Parameters		Atterberg's Limit	
		Start Depth	End Depth					Bulk Density	Dry Density		C (t/m ²)	Ø (°)	LL	PL
1	Clayey sand	0.00	5.50	5.50	3.50	44-100	29.50 -	1.89	1.56	21	0.90	26	31	21
2	Soft Disintegrated Rock	5.50	10.00	4.50		100	57.50	1.92	1.66	16	0.00	31	-	-

RECOMMENDATION FOR SAFE BEARING CAPACITY

(NBH-01):

Depth in 'm'	Width of Footing in 'm'	Safe Bearing Capacity (t/m ²) based on				
		Shear Consideration		Total Permissible Settlement up to (mm)		
		GSBC	NSBC	25	40	75
1.00	1 x 1	29.05	28.07	42.08	67.33	-
	2 x 2	28.54	27.56	28.28	45.25	-
	3 x 3	29.70	28.72	24.17	38.67	-
	4 x 4	31.28	30.30	22.35	35.76	-
	5 x 5	33.02	32.04	21.50	34.40	-
	6 x 6	33.60	32.62	20.45	32.72	61.35
2.00	1 x 1	48.77	46.82	53.09	84.94	-
	2 x 2	44.13	42.18	35.28	56.46	-
	3 x 3	43.91	41.96	29.46	47.13	-
	4 x 4	44.80	42.85	26.48	42.37	-
	5 x 5	46.13	44.18	24.87	39.79	-
	6 x 6	44.56	42.61	22.37	35.79	67.10
2.50	1 x 1	59.85	57.41	55.47	88.75	-
	2 x 2	52.53	50.09	37.74	60.39	-
	3 x 3	51.42	48.98	31.35	50.17	-
	4 x 4	51.87	49.43	28.10	44.95	-
	5 x 5	52.93	50.49	26.03	41.65	-
	6 x 6	50.21	47.77	23.10	36.96	69.29
3.00	1 x 1	71.74	68.81	82.10	131.36	-
	2 x 2	61.35	58.42	48.39	77.43	-
	3 x 3	59.21	56.28	37.81	60.49	-
	4 x 4	59.14	56.21	32.80	52.48	-
	5 x 5	59.90	56.97	29.78	47.65	-
	6 x 6	55.97	53.04	25.45	40.72	76.35

Table-1

RECOMMENDATION FOR SAFE BEARING CAPACITY

(NBH-01):

Depth in 'm'	Width of Footing in 'm'	Safe Bearing Capacity (t/m ²) based on			
		Shear Consideration		Total Permissible Settlement up to (mm)	
		GSBC	NSBC	25	40
1.00	1 x 1.5	27.66	26.68	34.44	55.11
	2 x 3	27.44	26.46	25.88	41.40
	3 x 4.5	28.37	27.39	23.24	37.18
	4 x 6	29.58	28.60	21.78	34.85
	5 x 7.5	30.90	29.92	20.92	33.47
2.00	1 x 1.5	45.58	43.63	43.15	69.04
	2 x 3	42.48	40.53	31.01	49.61
	3 x 4.5	42.44	40.49	27.36	43.77
	4 x 6	43.16	41.21	25.26	40.42
	5 x 7.5	44.20	42.25	24.21	38.74
2.50	1 x 1.5	55.43	52.99	45.74	73.18
	2 x 3	50.44	48.00	34.53	55.25
	3 x 4.5	49.77	47.33	28.73	45.96
	4 x 6	50.18	47.74	26.48	42.36
	5 x 7.5	51.03	48.59	25.06	40.09
3.00	1 x 1.5	65.86	62.93	61.18	97.89
	2 x 3	58.69	55.76	41.19	65.91
	3 x 4.5	57.30	54.37	32.81	52.49
	4 x 6	57.35	54.42	29.58	47.34
	5 x 7.5	57.98	55.05	27.63	44.20

Table-2

RECOMMENDATION FOR SAFE BEARING CAPACITY

(NBH-01):

Depth in 'm'	Width of Footing in 'm'	Safe Bearing Capacity (t/m ²) based on			
		Shear Consideration		Total Permissible Settlement up to (mm)	
		GSBC	NSBC	25	40
1.00	1 x 2	28.09	27.11	30.82	49.31
	2 x 4	27.70	26.72	24.43	39.08
	3 x 6	28.23	27.25	22.02	35.24
	4 x 8	29.00	28.02	21.04	33.66
	5 x 10	29.86	28.88	20.52	32.83
2.00	1 x 2	45.66	43.71	39.03	62.44
	2 x 4	42.94	40.99	28.86	46.17
	3 x 6	42.70	40.75	25.87	41.39
	4 x 8	43.08	41.13	24.38	39.00
	5 x 10	43.70	41.75	23.22	37.15
2.50	1 x 2	55.17	52.73	40.69	65.11
	2 x 4	50.93	48.49	30.34	48.55
	3 x 6	50.18	47.74	27.14	43.42
	4 x 8	50.30	47.86	25.24	40.38
	5 x 10	50.77	48.33	24.29	38.87
3.00	1 x 2	65.15	62.22	51.52	82.42
	2 x 4	59.15	56.22	37.08	59.32
	3 x 6	57.81	54.88	30.34	48.55
	4 x 8	57.64	54.71	28.08	44.93
	5 x 10	57.94	55.01	26.44	42.30

Table-3

RECOMMENDATION FOR SAFE BEARING CAPACITY

(NBH-02):

Depth in 'm'	Width of Footing in 'm'	Safe Bearing Capacity (t/m ²) based on				
		Shear Consideration		Total Permissible Settlement up to (mm)		
		GSBC	NSBC	25	40	75
1.00	1 x 1	25.06	24.10	29.56	47.29	-
	2 x 2	24.36	23.40	19.87	31.78	-
	3 x 3	25.10	24.14	16.98	27.16	-
	4 x 4	26.20	25.24	15.70	25.11	-
	5 x 5	27.44	26.48	15.10	24.16	-
	6 x 6	27.20	26.24	14.36	22.98	43.09
2.00	1 x 1	40.93	39.01	40.70	65.12	-
	2 x 2	36.83	34.91	27.05	43.28	-
	3 x 3	36.44	34.52	22.58	36.14	-
	4 x 4	36.98	35.06	20.30	32.48	-
	5 x 5	37.89	35.97	20.30	32.48	-
	6 x 6	35.93	34.01	17.15	27.44	51.45
2.50	1 x 1	49.77	47.37	48.15	77.05	-
	2 x 2	43.53	41.13	32.77	52.43	-
	3 x 3	42.42	40.02	27.22	43.55	-
	4 x 4	42.60	40.20	24.39	39.03	-
	5 x 5	43.29	40.89	22.60	36.16	-
	6 x 6	40.43	38.03	20.05	32.08	60.15
3.00	1 x 1	59.23	56.35	89.79	143.67	-
	2 x 2	50.53	47.65	50.17	80.27	-
	3 x 3	48.60	45.72	38.31	61.29	-
	4 x 4	48.37	45.49	32.82	52.50	-
	5 x 5	48.82	45.94	29.56	47.29	-
	6 x 6	45.01	42.13	25.12	40.19	75.35

Table-4

RECOMMENDATION FOR SAFE BEARING CAPACITY

(NBH-02):

Depth in 'm'	Width of Footing in 'm'	Safe Bearing Capacity (t/m ²) based on			
		Shear Consideration		Total Permissible Settlement up to (mm)	
		GSBC	NSBC	25	40
1.00	1 x 1.5	23.86	22.90	24.19	38.71
	2 x 3	23.48	22.52	18.18	29.08
	3 x 4.5	24.08	23.12	16.32	26.12
	4 x 6	24.94	23.98	15.30	24.48
	5 x 7.5	25.88	24.92	14.69	23.51
2.00	1 x 1.5	38.22	36.30	33.08	52.93
	2 x 3	35.48	33.56	23.77	38.04
	3 x 4.5	35.29	33.37	20.97	33.56
	4 x 6	35.75	33.83	19.37	30.99
	5 x 7.5	36.47	34.55	18.56	29.70
2.50	1 x 1.5	46.06	43.66	39.71	63.53
	2 x 3	41.81	39.41	29.98	47.97
	3 x 4.5	41.12	38.72	24.94	39.90
	4 x 6	41.33	38.93	22.99	36.78
	5 x 7.5	41.89	39.49	21.75	34.81
3.00	1 x 1.5	54.33	51.45	64.71	103.54
	2 x 3	48.35	45.47	41.74	66.78
	3 x 4.5	47.09	44.21	32.68	52.29
	4 x 6	47.01	44.13	29.20	46.72
	5 x 7.5	47.40	44.52	27.11	43.37

Table-5

RECOMMENDATION FOR SAFE BEARING CAPACITY

(NBH-02):

Depth in 'm'	Width of Footing in 'm'	Safe Bearing Capacity (t/m ²) based on			
		Shear Consideration		Total Permissible Settlement up to (mm)	
		GSBC	NSBC	25	40
1.00	1 x 2	24.31	23.35	21.65	34.64
	2 x 4	23.85	22.89	17.16	27.45
	3 x 6	24.18	23.22	15.47	24.75
	4 x 8	24.71	23.75	14.78	23.64
	5 x 10	25.33	24.37	14.41	23.06
2.00	1 x 2	38.36	36.44	29.92	47.87
	2 x 4	35.99	34.07	22.12	35.40
	3 x 6	35.69	33.77	19.83	31.74
	4 x 8	35.91	33.99	18.69	29.90
	5 x 10	36.33	34.41	17.80	28.48
2.50	1 x 2	45.92	43.52	35.33	56.52
	2 x 4	42.33	39.93	26.34	42.15
	3 x 6	41.62	39.22	23.56	37.70
	4 x 8	41.64	39.24	21.91	35.05
	5 x 10	41.94	39.54	21.09	33.74
3.00	1 x 2	53.83	50.95	53.41	85.45
	2 x 4	48.85	45.97	37.10	59.35
	3 x 6	47.68	44.80	29.95	47.91
	4 x 8	47.45	44.57	27.51	44.02
	5 x 10	47.61	44.73	25.78	41.26

Table-6

RECOMMENDATION FOR SAFE BEARING CAPACITY

(NBH-03):

Depth in 'm'	Width of Footing in 'm'	Safe Bearing Capacity (t/m ²) based on				
		Shear Consideration		Total Permissible Settlement up to (mm)		
		GSBC	NSBC	25	40	75
1.00	1 x 1	25.14	24.16	24.55	39.28	-
	2 x 2	24.44	23.46	16.50	26.40	-
	3 x 3	25.18	24.20	14.10	22.56	-
	4 x 4	26.29	25.31	13.04	20.86	-
	5 x 5	27.55	26.57	12.54	20.07	-
	6 x 6	27.31	26.33	11.93	19.09	35.79
2.00	1 x 1	41.08	39.13	40.70	65.12	-
	2 x 2	36.98	35.03	27.05	43.28	-
	3 x 3	36.59	34.64	22.58	36.14	-
	4 x 4	37.14	35.19	20.30	32.48	-
	5 x 5	38.05	36.10	19.07	30.50	-
	6 x 6	36.10	34.15	17.15	27.44	51.45
2.50	1 x 1	49.97	47.53	49.37	79.00	-
	2 x 2	43.71	41.27	33.60	53.76	-
	3 x 3	42.61	40.17	27.91	44.65	-
	4 x 4	42.79	40.35	25.01	40.01	-
	5 x 5	43.49	41.05	23.17	37.07	-
	6 x 6	40.63	38.19	20.56	32.89	61.68
3.00	1 x 1	59.47	56.54	61.80	98.87	-
	2 x 2	50.75	47.82	42.50	67.99	-
	3 x 3	48.83	45.90	35.15	56.24	-
	4 x 4	48.60	45.67	31.42	50.27	-
	5 x 5	49.05	46.12	29.06	46.50	-
	6 x 6	45.24	42.31	27.45	43.91	75.42

Table-7

RECOMMENDATION FOR SAFE BEARING CAPACITY

(NBH-03):

Depth in 'm'	Width of Footing in 'm'	Safe Bearing Capacity (t/m ²) based on			
		Shear Consideration		Total Permissible Settlement up to (mm)	
		GSBC	NSBC	25	40
1.00	1 x 1.5	23.94	22.96	20.09	32.15
	2 x 3	23.56	22.58	15.09	24.15
	3 x 4.5	24.17	23.19	13.56	21.69
	4 x 6	25.03	24.05	12.71	20.33
	5 x 7.5	25.98	25.00	12.20	19.52
2.00	1 x 1.5	38.37	36.42	33.08	52.93
	2 x 3	35.62	33.67	23.77	38.04
	3 x 4.5	35.44	33.49	20.97	33.56
	4 x 6	35.90	33.95	19.37	30.99
	5 x 7.5	36.62	34.67	18.56	29.70
2.50	1 x 1.5	46.25	43.81	40.71	65.14
	2 x 3	41.99	39.55	30.74	49.18
	3 x 4.5	41.30	38.86	25.57	40.91
	4 x 6	41.51	39.07	23.57	37.71
	5 x 7.5	42.08	39.64	22.31	35.69
3.00	1 x 1.5	54.57	51.64	50.90	81.44
	2 x 3	48.57	45.64	38.30	61.28
	3 x 4.5	47.31	44.38	31.75	50.80
	4 x 6	47.23	44.30	29.23	46.76
	5 x 7.5	47.63	44.70	27.64	44.22

Table-8

RECOMMENDATION FOR SAFE BEARING CAPACITY

(NBH-03):

Depth in 'm'	Width of Footing in 'm'	Safe Bearing Capacity (t/m ²) based on			
		Shear Consideration		Total Permissible Settlement up to (mm)	
		GSBC	NSBC	25	40
1.00	1 x 2	24.39	23.41	17.98	28.77
	2 x 4	23.93	22.95	14.25	22.80
	3 x 6	24.26	23.28	12.85	20.56
	4 x 8	24.80	23.82	12.27	19.64
	5 x 10	25.42	24.44	11.97	19.15
2.00	1 x 2	38.51	36.56	29.92	47.87
	2 x 4	36.14	34.19	22.12	35.40
	3 x 6	35.84	33.89	19.83	31.74
	4 x 8	36.06	34.11	18.69	29.90
	5 x 10	36.48	34.53	17.80	28.48
2.50	1 x 2	46.11	43.67	36.22	57.95
	2 x 4	42.52	40.08	27.01	43.21
	3 x 6	41.81	39.37	24.16	38.65
	4 x 8	41.82	39.38	22.46	35.94
	5 x 10	42.12	39.68	21.62	34.60
3.00	1 x 2	54.07	51.14	45.24	72.38
	2 x 4	49.07	46.14	35.52	56.83
	3 x 6	47.90	44.97	29.98	47.96
	4 x 8	47.68	44.75	28.18	45.09
	5 x 10	47.84	44.91	26.78	42.86

Table-9

RECOMMENDATION FOR SAFE BEARING CAPACITY

(NBH-04):

Depth in 'm'	Width of Footing in 'm'	Safe Bearing Capacity (t/m ²) based on				
		Shear Consideration		Total Permissible Settlement up to (mm)		
		GSBC	NSBC	25	40	75
1.00	1 x 1	25.75	24.78	27.05	43.29	-
	2 x 2	25.19	24.22	18.18	29.09	-
	3 x 3	26.10	25.13	15.54	24.86	-
	4 x 4	27.38	26.41	14.37	22.99	-
	5 x 5	28.80	27.83	13.82	22.11	-
	6 x 6	28.98	28.01	13.15	21.03	39.44
2.00	1 x 1	42.90	40.97	40.70	65.12	-
	2 x 2	38.75	36.82	27.05	43.28	-
	3 x 3	38.47	36.54	22.58	36.14	-
	4 x 4	39.15	37.22	20.30	32.48	-
	5 x 5	40.22	38.29	19.07	30.50	-
	6 x 6	38.53	36.60	17.15	27.44	51.45
2.50	1 x 1	52.50	50.09	51.20	81.92	-
	2 x 2	46.05	43.64	34.84	55.75	-
	3 x 3	45.00	42.59	28.94	46.31	-
	4 x 4	45.29	42.88	25.93	41.50	-
	5 x 5	46.13	43.72	24.03	38.45	-
	6 x 6	43.44	41.03	21.32	34.11	63.96
3.00	1 x 1	62.80	59.90	68.73	109.97	-
	2 x 2	53.70	50.80	47.27	75.63	-
	3 x 3	51.76	48.86	39.10	62.56	-
	4 x 4	51.62	48.72	34.95	55.92	-
	5 x 5	52.19	49.29	32.32	51.71	-
	6 x 6	48.47	45.57	27.96	44.74	83.89

Table-10

RECOMMENDATION FOR SAFE BEARING CAPACITY

(NBH-04):

Depth in 'm'	Width of Footing in 'm'	Safe Bearing Capacity (t/m ²) based on			
		Shear Consideration		Total Permissible Settlement up to (mm)	
		GSBC	NSBC	25	40
1.00	1 x 1.5	24.55	23.58	22.14	35.43
	2 x 3	24.27	23.30	16.64	26.62
	3 x 4.5	25.00	24.03	14.94	23.90
	4 x 6	25.98	25.01	14.00	22.41
	5 x 7.5	27.07	26.10	13.45	21.51
2.00	1 x 1.5	40.14	38.21	33.08	52.93
	2 x 3	37.36	35.43	23.77	38.04
	3 x 4.5	37.25	35.32	20.97	33.56
	4 x 6	37.82	35.89	19.37	30.99
	5 x 7.5	38.65	36.72	18.56	29.70
2.50	1 x 1.5	48.67	46.26	42.22	67.55
	2 x 3	44.27	41.86	31.88	51.00
	3 x 4.5	43.63	41.22	26.52	42.43
	4 x 6	43.92	41.51	24.44	39.11
	5 x 7.5	44.59	42.18	23.13	37.01
3.00	1 x 1.5	57.72	54.82	56.61	90.58
	2 x 3	51.44	48.54	42.60	68.16
	3 x 4.5	50.18	47.28	35.31	56.50
	4 x 6	50.16	47.26	32.51	52.01
	5 x 7.5	50.64	47.74	30.74	49.18

Table-11

RECOMMENDATION FOR SAFE BEARING CAPACITY

(NBH-04):

Depth in 'm'	Width of Footing in 'm'	Safe Bearing Capacity (t/m^2) based on			
		Shear Consideration		Total Permissible Settlement up to (mm)	
		GSBC	NSBC	25	40
1.00	1 x 2	24.97	24.00	19.81	31.70
	2 x 4	24.57	23.60	15.70	25.12
	3 x 6	24.99	24.02	14.16	22.65
	4 x 8	25.61	24.64	13.53	21.64
	5 x 10	26.31	25.34	13.19	21.10
2.00	1 x 2	40.26	38.33	29.92	47.87
	2 x 4	37.84	35.91	22.12	35.40
	3 x 6	37.58	35.65	19.83	31.74
	4 x 8	37.87	35.94	18.69	29.90
	5 x 10	38.36	36.43	17.80	28.48
2.50	1 x 2	48.50	46.09	37.56	60.10
	2 x 4	44.78	42.37	28.01	44.82
	3 x 6	44.08	41.67	25.05	40.08
	4 x 8	44.15	41.74	23.29	37.27
	5 x 10	44.51	42.10	22.42	35.88
3.00	1 x 2	57.16	54.26	50.32	80.50
	2 x 4	51.92	49.02	39.51	63.21
	3 x 6	50.72	47.82	33.34	53.35
	4 x 8	50.54	47.64	31.35	50.15
	5 x 10	50.75	47.85	29.79	47.67

Table-12

RECOMMENDATION FOR SAFE BEARING CAPACITY

(NBH-05):

Depth in 'm'	Width of Footing in 'm'	Safe Bearing Capacity (t/m ²) based on				
		Shear Consideration		Total Permissible Settlement up to (mm)		
		GSBC	NSBC	25	40	75
1.00	1 x 1	27.10	26.13	29.56	47.29	-
	2 x 2	26.37	25.40	19.87	31.78	-
	3 x 3	27.21	26.24	16.98	27.16	-
	4 x 4	28.45	27.48	15.70	25.11	-
	5 x 5	29.85	28.88	15.10	24.16	-
	6 x 6	29.74	28.77	14.36	22.98	43.09
2.00	1 x 1	44.52	42.59	46.60	74.56	-
	2 x 2	40.04	38.11	30.97	49.56	-
	3 x 3	39.64	37.71	25.86	41.37	-
	4 x 4	40.26	38.33	23.24	37.19	-
	5 x 5	41.28	39.35	21.83	34.93	-
	6 x 6	39.29	37.36	19.63	31.41	58.90
2.50	1 x 1	54.25	51.84	57.30	91.68	-
	2 x 2	47.39	44.98	38.99	62.38	-
	3 x 3	46.20	43.79	32.39	51.82	-
	4 x 4	46.42	44.01	29.02	46.44	-
	5 x 5	47.20	44.79	26.89	43.02	-
	6 x 6	44.21	41.80	23.86	38.17	71.58
3.00	1 x 1	64.67	61.77	68.73	109.97	-
	2 x 2	55.09	52.19	47.27	75.63	-
	3 x 3	52.99	50.09	39.10	62.56	-
	4 x 4	52.76	49.86	34.95	55.92	-
	5 x 5	53.27	50.37	32.32	51.71	-
	6 x 6	49.23	46.33	27.96	44.74	83.89

Table-13

RECOMMENDATION FOR SAFE BEARING CAPACITY

(NBH-05):

Depth in 'm'	Width of Footing in 'm'	Safe Bearing Capacity (t/m ²) based on			
		Shear Consideration		Total Permissible Settlement up to (mm)	
		GSBC	NSBC	25	40
1.00	1 x 1.5	25.79	24.82	24.19	38.71
	2 x 3	25.40	24.43	18.18	29.08
	3 x 4.5	26.08	25.11	16.32	26.12
	4 x 6	27.04	26.07	15.30	24.48
	5 x 7.5	28.11	27.14	14.69	23.51
2.00	1 x 1.5	41.53	39.60	37.87	60.60
	2 x 3	38.53	36.60	27.22	43.55
	3 x 4.5	38.35	36.42	24.01	38.42
	4 x 6	38.88	36.95	22.17	35.48
	5 x 7.5	39.68	37.75	21.25	34.01
2.50	1 x 1.5	50.15	47.74	47.25	75.59
	2 x 3	45.47	43.06	35.67	57.08
	3 x 4.5	44.73	42.32	29.67	47.48
	4 x 6	44.98	42.57	27.35	43.76
	5 x 7.5	45.62	43.21	25.88	41.42
3.00	1 x 1.5	59.26	56.36	56.61	90.58
	2 x 3	52.67	49.77	42.60	68.16
	3 x 4.5	51.29	48.39	35.31	56.50
	4 x 6	51.21	48.31	32.51	52.01
	5 x 7.5	51.66	48.76	30.74	49.18

Table-14

RECOMMENDATION FOR SAFE BEARING CAPACITY

(NBH-05):

Depth in 'm'	Width of Footing in 'm'	Safe Bearing Capacity (t/m ²) based on			
		Shear Consideration		Total Permissible Settlement up to (mm)	
		GSBC	NSBC	25	40
1.00	1 x 2	26.25	25.28	21.65	34.64
	2 x 4	25.76	24.79	17.16	27.45
	3 x 6	26.14	25.17	15.47	24.75
	4 x 8	26.74	25.77	14.78	23.64
	5 x 10	27.43	26.46	14.41	23.06
2.00	1 x 2	41.65	39.72	34.26	54.81
	2 x 4	39.06	37.13	25.33	40.53
	3 x 6	38.74	36.81	22.71	36.33
	4 x 8	38.99	37.06	21.40	34.24
	5 x 10	39.46	37.53	20.38	32.61
2.50	1 x 2	49.95	47.54	42.04	67.26
	2 x 4	46.01	43.60	31.34	50.15
	3 x 6	45.24	42.83	28.03	44.85
	4 x 8	45.26	42.85	26.07	41.71
	5 x 10	45.60	43.19	25.09	40.15
3.00	1 x 2	58.66	55.76	50.32	80.50
	2 x 4	53.16	50.26	39.51	63.21
	3 x 6	51.88	48.98	33.34	53.35
	4 x 8	51.64	48.74	31.35	50.15
	5 x 10	51.83	48.93	29.79	47.67

Table-15

RECOMMENDATION FOR SAFE BEARING CAPACITY

(NBH-06):

Depth in 'm'	Width of Footing in 'm'	Safe Bearing Capacity (t/m ²) based on				
		Shear Consideration		Total Permissible Settlement up to (mm)		
		GSBC	NSBC	25	40	75
1.00	1 x 1	24.37	23.39	27.05	43.29	-
	2 x 2	23.55	22.57	18.18	29.09	-
	3 x 3	24.14	23.16	15.54	24.86	-
	4 x 4	25.09	24.11	14.37	22.99	-
	5 x 5	26.17	25.19	13.82	22.11	-
	6 x 6	25.56	24.58	13.15	21.03	39.44
2.00	1 x 1	39.10	37.14	40.70	65.12	-
	2 x 2	35.07	33.11	27.05	43.28	-
	3 x 3	34.59	32.63	22.58	36.14	-
	4 x 4	35.00	33.04	20.30	32.48	-
	5 x 5	35.77	33.81	19.07	30.50	-
	6 x 6	33.59	31.63	17.15	27.44	51.45
2.50	1 x 1	47.27	44.81	54.25	86.80	-
	2 x 2	41.24	38.78	36.92	59.06	-
	3 x 3	40.10	37.64	30.66	49.06	-
	4 x 4	40.17	37.71	27.48	43.97	-
	5 x 5	40.74	38.28	25.46	40.74	-
	6 x 6	37.73	35.27	22.59	36.14	67.77
3.00	1 x 1	55.98	53.03	68.73	109.97	-
	2 x 2	47.68	44.73	47.27	75.63	-
	3 x 3	45.77	42.82	39.10	62.56	-
	4 x 4	45.47	42.52	34.95	55.92	-
	5 x 5	45.81	42.86	32.32	51.71	-
	6 x 6	41.93	39.98	27.96	44.74	83.89

Table-16

RECOMMENDATION FOR SAFE BEARING CAPACITY

(NBH-06):

Depth in 'm'	Width of Footing in 'm'	Safe Bearing Capacity (t/m ²) based on			
		Shear Consideration		Total Permissible Settlement up to (mm)	
		GSBC	NSBC	25	40
1.00	1 x 1.5	23.19	22.21	22.14	35.43
	2 x 3	22.72	21.74	16.64	26.62
	3 x 4.5	23.21	22.23	14.94	23.90
	4 x 6	23.94	22.96	14.00	22.41
	5 x 7.5	24.77	23.79	13.45	21.51
2.00	1 x 1.5	36.45	34.49	33.08	52.93
	2 x 3	33.76	31.80	23.77	38.04
	3 x 4.5	33.51	31.55	20.97	33.56
	4 x 6	33.87	31.91	19.37	30.99
	5 x 7.5	34.48	32.52	18.56	29.70
2.50	1 x 1.5	43.68	41.22	44.73	71.57
	2 x 3	39.58	37.12	33.78	54.04
	3 x 4.5	38.86	36.40	28.09	44.95
	4 x 6	38.99	36.53	25.90	41.43
	5 x 7.5	39.46	37.00	24.51	39.21
3.00	1 x 1.5	51.28	48.33	56.61	90.58
	2 x 3	45.58	42.63	42.60	68.16
	3 x 4.5	44.33	41.38	35.31	56.50
	4 x 6	44.20	41.25	32.51	52.01
	5 x 7.5	44.50	41.55	30.74	49.18

Table-17

RECOMMENDATION FOR SAFE BEARING CAPACITY

(NBH-06):

Depth in 'm'	Width of Footing in 'm'	Safe Bearing Capacity (t/m ²) based on			
		Shear Consideration		Total Permissible Settlement up to (mm)	
		GSBC	NSBC	25	40
1.00	1 x 2	23.66	22.68	19.81	31.70
	2 x 4	23.14	22.16	15.70	25.12
	3 x 6	23.41	22.43	14.16	22.65
	4 x 8	23.86	22.88	13.53	21.64
	5 x 10	24.39	23.41	13.19	21.10
2.00	1 x 2	36.62	34.66	29.92	47.87
	2 x 4	34.30	32.34	22.12	35.40
	3 x 6	33.96	32.00	19.83	31.74
	4 x 8	34.12	32.16	18.69	29.90
	5 x 10	34.47	32.51	17.80	28.48
2.50	1 x 2	43.58	41.12	39.80	63.68
	2 x 4	40.13	37.67	29.68	47.48
	3 x 6	39.41	36.95	26.54	42.47
	4 x 8	39.38	36.92	24.68	39.49
	5 x 10	39.62	37.16	23.76	38.02
3.00	1 x 2	50.84	47.89	50.32	80.50
	2 x 4	46.10	43.15	39.51	63.21
	3 x 6	44.95	42.00	33.34	53.35
	4 x 8	44.70	41.75	31.35	50.15
	5 x 10	44.81	41.86	29.79	47.67

Table-18

RECOMMENDATION FOR SAFE BEARING CAPACITY

(NBH-07):

Depth in 'm'	Width of Footing in 'm'	Safe Bearing Capacity (t/m ²) based on				
		Shear Consideration		Total Permissible Settlement up to (mm)		
		GSBC	NSBC	25	40	75
1.00	1 x 1	25.42	24.22	29.56	47.29	-
	2 x 2	24.74	23.52	19.87	31.78	-
	3 x 3	25.52	24.27	16.98	27.16	-
	4 x 4	26.67	25.39	15.70	25.11	-
	5 x 5	27.96	26.65	15.10	24.16	-
	6 x 6	27.78	26.43	14.36	22.98	43.09
2.00	1 x 1	67.68	65.74	64.30	102.88	-
	2 x 2	64.92	62.98	42.73	68.37	-
	3 x 3	67.37	65.43	35.68	57.08	-
	4 x 4	71.11	69.17	32.07	51.31	-
	5 x 5	75.37	73.43	30.12	48.19	-
	6 x 6	80.26	78.32	27.09	43.34	81.27
2.50	1 x 1	88.22	85.79	66.44	106.30	-
	2 x 2	81.08	78.65	45.21	72.34	-
	3 x 3	82.06	79.63	37.56	60.09	-
	4 x 4	85.07	82.64	33.65	53.85	-
	5 x 5	88.89	86.46	31.18	49.89	-
	6 x 6	91.55	89.12	27.67	44.27	83.00
3.00	1 x 1	110.70	107.79	68.73	109.97	-
	2 x 2	98.19	95.28	47.27	75.63	-
	3 x 3	97.38	94.47	39.10	62.56	-
	4 x 4	99.50	96.59	34.95	55.92	-
	5 x 5	102.79	99.88	32.32	51.71	-
	6 x 6	103.11	100.20	27.96	44.74	83.89

Table-19

RECOMMENDATION FOR SAFE BEARING CAPACITY

(NBH-07):

Depth in 'm'	Width of Footing in 'm'	Safe Bearing Capacity (t/m ²) based on			
		Shear Consideration		Total Permissible Settlement up to (mm)	
		GSBC	NSBC	25	40
1.00	1 x 1.5	24.22	23.25	24.19	38.71
	2 x 3	23.85	22.88	18.18	29.08
	3 x 4.5	24.49	23.52	16.32	26.12
	4 x 6	25.37	24.40	15.30	24.48
	5 x 7.5	26.35	25.38	14.69	23.51
2.00	1 x 1.5	64.79	62.85	52.26	83.61
	2 x 3	62.94	61.00	37.56	60.09
	3 x 4.5	64.84	62.90	33.13	53.01
	4 x 6	67.68	65.74	30.60	48.95
	5 x 7.5	70.90	68.96	29.33	46.92
2.50	1 x 1.5	83.56	81.13	54.79	87.66
	2 x 3	78.54	76.11	41.36	66.18
	3 x 4.5	79.39	76.96	34.41	55.05
	4 x 6	81.71	79.28	31.71	50.74
	5 x 7.5	84.61	82.18	30.02	48.02
3.00	1 x 1.5	103.74	100.83	56.61	90.58
	2 x 3	94.84	91.93	42.60	68.16
	3 x 4.5	94.40	91.49	35.31	56.50
	4 x 6	96.07	93.16	32.51	52.01
	5 x 7.5	98.58	95.67	30.74	49.18

Table-20

RECOMMENDATION FOR SAFE BEARING CAPACITY

(NBH-07):

Depth in 'm'	Width of Footing in 'm'	Safe Bearing Capacity (t/m ²) based on			
		Shear Consideration		Total Permissible Settlement up to (mm)	
		GSBC	NSBC	25	40
1.00	1 x 2	24.67	23.70	21.65	34.64
	2 x 4	24.21	23.24	17.16	27.45
	3 x 6	24.57	23.60	15.47	24.75
	4 x 8	25.12	24.15	14.78	23.64
	5 x 10	25.76	24.79	14.41	23.06
2.00	1 x 2	64.51	62.57	47.27	75.63
	2 x 4	62.48	60.54	34.95	55.92
	3 x 6	63.49	61.55	31.33	50.13
	4 x 8	65.25	63.31	29.52	47.24
	5 x 10	67.32	65.38	28.12	44.99
2.50	1 x 2	64.51	80.43	48.74	77.99
	2 x 4	62.48	75.84	36.35	58.15
	3 x 6	63.49	75.99	32.51	52.01
	4 x 8	65.25	77.33	30.23	48.36
	5 x 10	67.32	79.14	29.10	46.56
3.00	1 x 2	102.33	99.42	50.32	80.50
	2 x 4	94.62	91.71	39.51	63.21
	3 x 6	93.72	90.81	33.34	53.35
	4 x 8	94.54	91.63	31.35	50.15
	5 x 10	96.04	93.13	29.79	47.67

Table-21

RECOMMENDATION FOR SAFE BEARING CAPACITY

(NBH-08):

Depth in 'm'	Width of Footing in 'm'	Safe Bearing Capacity (t/m ²) based on				
		Shear Consideration		Total Permissible Settlement up to (mm)		
		GSBC	NSBC	25	40	75
1.00	1 x 1	28.97	28.00	24.55	39.28	-
	2 x 2	28.45	27.48	16.50	26.40	-
	3 x 3	29.60	28.63	14.10	22.56	-
	4 x 4	31.17	30.20	13.04	20.86	-
	5 x 5	32.90	31.93	12.54	20.07	-
	6 x 6	33.47	32.50	11.93	19.09	35.79
2.00	1 x 1	48.60	46.66	34.80	55.68	-
	2 x 2	43.97	42.03	23.13	37.01	-
	3 x 3	43.74	41.80	19.31	30.90	-
	4 x 4	44.63	42.69	17.36	27.77	-
	5 x 5	45.95	44.01	16.30	26.08	-
	6 x 6	44.37	42.43	14.66	23.46	43.99
2.50	1 x 1	59.63	57.20	42.06	67.29	-
	2 x 2	52.34	49.91	28.62	45.79	-
	3 x 3	51.23	48.80	23.77	38.04	-
	4 x 4	51.66	49.23	21.30	34.09	-
	5 x 5	52.72	50.29	19.74	31.58	-
	6 x 6	49.99	47.56	17.51	28.02	52.54
3.00	1 x 1	71.47	68.56	76.61	122.58	-
	2 x 2	61.10	58.19	43.91	70.25	-
	3 x 3	58.97	56.06	33.90	54.24	-
	4 x 4	58.89	55.98	29.22	46.75	-
	5 x 5	59.64	56.73	26.42	42.27	-
	6 x 6	55.72	52.81	22.51	36.02	67.54

Table-22

RECOMMENDATION FOR SAFE BEARING CAPACITY

(NBH-08):

Depth in 'm'	Width of Footing in 'm'	Safe Bearing Capacity (t/m ²) based on			
		Shear Consideration		Total Permissible Settlement up to (mm)	
		GSBC	NSBC	25	40
1.00	1 x 1.5	27.58	26.61	20.09	32.15
	2 x 3	27.35	26.38	15.09	24.15
	3 x 4.5	28.27	27.30	13.56	21.69
	4 x 6	29.47	28.50	12.71	20.33
	5 x 7.5	30.79	29.82	12.20	19.52
2.00	1 x 1.5	45.42	43.48	28.29	45.26
	2 x 3	42.32	40.38	20.33	32.52
	3 x 4.5	42.28	40.34	17.93	28.70
	4 x 6	43.00	41.06	16.56	26.50
	5 x 7.5	44.03	42.09	15.87	25.40
2.50	1 x 1.5	55.22	52.79	34.68	55.49
	2 x 3	50.24	47.81	26.19	41.90
	3 x 4.5	49.58	47.15	21.78	34.85
	4 x 6	49.98	47.55	20.08	32.12
	5 x 7.5	50.82	48.39	19.00	30.40
3.00	1 x 1.5	65.60	62.69	56.09	89.75
	2 x 3	58.45	55.54	36.93	59.09
	3 x 4.5	57.06	54.15	29.16	46.65
	4 x 6	57.11	54.20	26.17	41.87
	5 x 7.5	57.73	54.82	24.37	38.98

Table-23

RECOMMENDATION FOR SAFE BEARING CAPACITY

(NBH-08):

Depth in 'm'	Width of Footing in 'm'	Safe Bearing Capacity (t/m ²) based on			
		Shear Consideration		Total Permissible Settlement up to (mm)	
		GSBC	NSBC	25	40
1.00	1 x 2	28.00	27.03	17.98	28.77
	2 x 4	27.61	26.64	14.25	22.80
	3 x 6	28.14	27.17	12.85	20.56
	4 x 8	28.90	27.93	12.27	19.64
	5 x 10	29.76	28.79	11.97	19.15
2.00	1 x 2	45.50	43.56	25.58	40.93
	2 x 4	42.79	40.85	18.92	30.27
	3 x 6	42.54	40.60	16.96	27.14
	4 x 8	42.91	40.97	15.98	25.57
	5 x 10	43.54	41.60	15.22	24.35
2.50	1 x 2	54.96	52.53	30.86	49.37
	2 x 4	50.73	48.30	23.01	36.81
	3 x 6	49.98	47.55	20.58	32.93
	4 x 8	50.10	47.67	19.13	30.62
	5 x 10	50.57	48.14	18.42	29.47
3.00	1 x 2	64.89	61.98	46.74	74.78
	2 x 4	58.90	55.99	33.03	52.84
	3 x 6	57.57	54.66	26.84	42.95
	4 x 8	57.40	54.49	24.75	39.60
	5 x 10	57.69	54.78	23.25	37.19

Table-24

Note:

- Allowable bearing capacity is calculated based on the permissible settlement of 25mm in case of Soil and 12mm in case of Rock.
- For Isolated/Strip Foundation, bearing capacity is considered upto 6m width and for Raft foundation bearing capacity is considered for >6m.
- For Permissible Differential Settlement/ tilt shall be followed as per IS: 1904, 1986 and IS: 13063, 1991.
- * However, the actual depth of Rock Strata shall be verified at the time of foundation laying.
 *GSBC: Gross Safe Bearing Capacity
 *NSBC: Net Safe Bearing Capacity

ABSTRACT OF SAFE BEARING CAPACITY (FROM PLT)

PLT NO	Depth (m)	Plate Size B _p (m)	Footing Size B (m)	Allowable Settlement of Footing		Allowable Capacity from PLT graph	
				S _t (mm)		(When S _t =25mm)	(When S _t =40mm)
01	2.00	0.45	3	25	40	26.63	42.61
			5	25	40	21.76	34.81
02	2.00	0.45	3	25	40	32.14	51.42
			5	25	40	28.68	45.88

Table-25

RECOMMENDATIONS FOR BOARED CAST IN-SITU PILE

Pile Diameter (m)	Length of Pile in mtr (below cut-off level).	Safe load Capacity		
		Vertical Comp (MT)	Pull out (MT)	Lateral (MT)
0.45	7.00	22.86	13.17	7.20
0.50		26.38	14.70	8.01
0.60		34.03	17.79	9.61

Table-26

Note:

Cut-off level is considered as 3.00m below FGL.

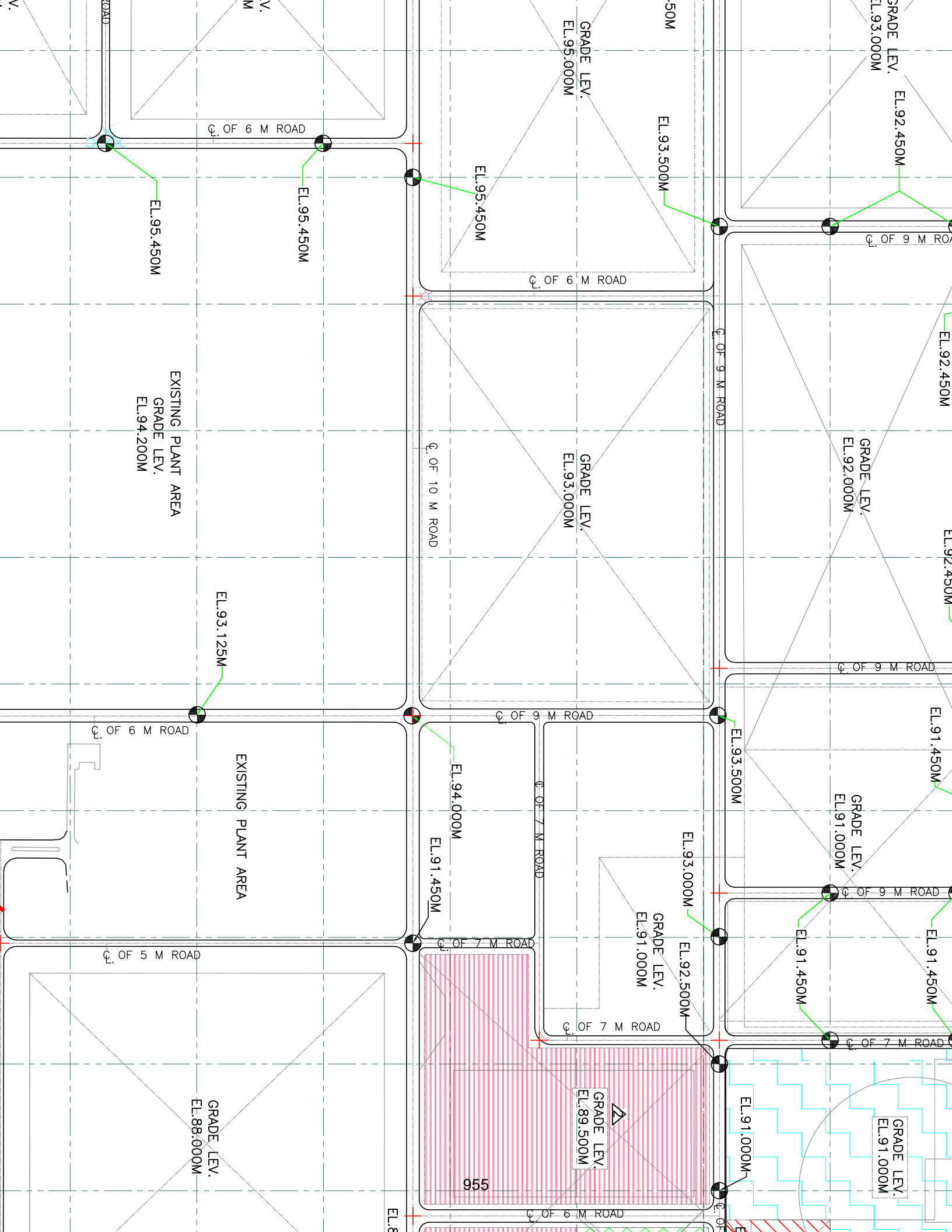
Factor of Safety is considered as 3.

Depth of foundation of pile is calculated from FGL.

DISCUSSION AND RECOMMENDATIONS

Based on the field and laboratory test results and the given Recommendations the following are summarized below:

- The sub-surface conditions encountered at the site during the geotechnical investigation, following are the observations made:
- For N Boreholes-01 was carried out up to a depth an average depth of 15.00m in the location. It is observed that top strata is mostly clayey sand, underlain Soft Disintegrated Rock.
- For N Boreholes-02 to 08 were carried out up to a depth an average depth of 10.00m in the location. It is observed that top strata is mostly clayey sand, underlain Soft Disintegrated Rock.
- By interpreting the field and laboratory test results, analysis of Safe Bearing Capacity (SBC) in Shallow foundation was calculated and tabulated from Table – 01 to 24.
- Based on the capacities evaluated suitable foundations shall be considered. Please refer from Table -01 to 24 for recommended SBC values.
Note: Consultant may adopt suitable type and size of footing, as per their loading requirement.
- Stratum at the founding level shall be thoroughly checked before placing the foundations on soil. If any loose soil pockets or cavities are present / noticed, the same shall be replaced with lean concrete before placing the foundations.
- From the laboratory test results and analysis, it reveals that does not possess any expansion. So, no special treatment is necessary.
- Chemical tests were conducted on water samples collected from the boreholes indicates that the chemical contents (pH, Chloride & Sulphate) are well within the permissible limits. Hence no special precautions are necessary for concreting job.
- Compaction tests, field & laboratory CBR test results are presented in the report. The design CBR of 9% in soaked condition may be used for pavement design wherever roads are to be constructed in cutting. Wherever roads are to be constructed in fill, the CBR value in soaked condition shall be determined from the filled material in laboratory.



GRADE LEV.
EL.93.000M

EL.92.450M

C. OF 9 M ROAD

EL.92.450M

GRADE LEV.
EL.92.000M

EL.92.450M

C. OF 9 M ROAD

EL.91.450M

GRADE LEV.
EL.91.000M

EL.91.450M

C. OF 9 M ROAD

EL.91.450M

C. OF 7 M ROAD

EL.91.000M

GRADE LEV.
EL.91.000M

50M

EL.93.500M

GRADE LEV.
EL.95.000M

EL.95.450M

C. OF 6 M ROAD

C. OF 9 M ROAD

GRADE LEV.
EL.93.000M

C. OF 10 M ROAD

C. OF 9 M ROAD

EL.94.000M

EL.91.450M

C. OF 7 M ROAD

EL.93.000M

GRADE LEV.
EL.91.000M

EL.92.500M

C. OF 7 M ROAD

ROAD

C. OF 6 M ROAD

EL.95.450M

EL.95.450M

EXISTING PLANT AREA
GRADE LEV.
EL.94.200M

EL.93.125M

C. OF 6 M ROAD

EXISTING PLANT AREA

C. OF 5 M ROAD

GRADE LEV.
EL.88.000M

955

C. OF 6 M ROAD

EL.8

PART-29

SWITCHYARD STRUCTURES

STRUCTURES FOR OUTDOOR EQUIPMENT

TABLE OF CONTENTS

- 1. GENERAL**
- 2. SUPPORT STRUCTURES OF SWITCHYARD**
- 3. INSPECTION BEFORE DISPATCH**
- 4. ERECTION**
- 5. WIDTH AND HEIGHT OF THE BUS AT SUB-STATION**

1. GENERAL:

1.1 Design of structures:

Substation structures shall be designed in accordance with the requirements of IS 802. The wind pressures for the substation sites shall be as per site data in schedules and wind pressure map of the State of Orissa. The Employer intends to use OPTCL approved design lattice structures.

Structures shall be designed to carry the equipment and associated connections, insulator sets, earth conductors and all fittings under all specified conditions of service of operation and loading.

The substation gantry structures shall be designed to carry the down lead spans and the Successful shall be provided with the details and location of the terminal tower and the type of conductor used on the overhead line in order to do so. All structures intended to carry equipment or materials on more than one side of the structure shall be designed to cater for all possible stages of equipment erection, installation and maintenance. The substation gantry structures shall be designed to terminate the overhead line down lead spans which may enter ± 30 degrees horizontally and ± 15 degrees vertically.

1.2 Conductor spacing and clearances:

Structures shall be dimensioned to maintain the specified minimum phase to earth, phase to phase and insulation height clearances under conditions of maximum conductor swing and sag. The spacing between individual phase conductors, and the clearance between clamps, arcing horns, jumper loops or other live metal and the structure steelwork and other obstacles, under all specified conditions of temperature and loading shall not be less than the specified values.

1.3 Applied loads:

The assumed maximum simultaneous loadings on the substation structures shall be as follows—

1.3.1 Wind loads:

The normal wind load shall be given by the wind pressure, as stated in the Schedules, acting on the whole projected area of the phase and earth conductors and, where applicable, the horizontal resultant of the maximum line and earth conductor tensions, together with the wind pressure, as stated in the Schedules, on 1.5 times the projected area of the members of one face of the structure plus the projected area of the plant being supported.

1.3.2 Vertical loads:

The normal vertical load shall be the mass of the line and earth conductors, insulators, the plant item, insulator fittings, earth conductor fittings, spacers, line traps and ancillary apparatus where applicable. For the overhead line terminating span it shall be assumed that the mass of the conductors and earth wires shall include the actual total mass of the down lead span.

1.4 Electro mechanical loads:

Electro dynamic forces due to short circuit conditions, snatch forces, aeolin vibration and other similar loads shall be computed and applied for design of structures. The different mechanical effects due to short circuit current etc. shall be estimated as per IEC865 and CIGRE guideline No. 7

1.5 Construction:

The structure shall be of an approved design and construction. All stressed members (tension and compression) of steel structures shall consist of rolled steel sections unless otherwise approved.

The material used for the members shall not be less than 6mm thick except for stressed members where the thickness may be reduced to 4mm.

No bolt hole shall be more than 1.5mm larger than the corresponding bolt diameter. As far as possible, bolt heads, rather than nuts, shall be on the outer or upper faces of structure connections.

To facilitate inspection and maintenance, all tall structures shall be provided with step bolts and ladders complete with hoops. Handrails, screens, guards and other appropriate facilities shall also be provided.

Where the structure is to terminate overhead transmission lines supplied under another contract, suitable provisions shall be made to accept the transmission line insulator fittings and earth conductor clamps.

Means shall be provided for fixing and bonding GI flat strip to the steelwork at a minimum of two points. Earth connections shall be made to a vertical face, clear of the ground. Foundation bolts shall not be used for the attachment. GI flats for earth connections, bolts, nuts washers etc., shall be included in the structures.

Gantry type structures which support more than one three phase circuit shall have suitable inter bay screens installed to prevent access along the beam from a dead to an energized circuit. The location of the screens shall be agreed with the Engg. Incharge (Divisional Engr.).

1.6 Material:

All rolled steel sections, flats, plates and bolt and nut bars used shall consist of steel manufactured by an approved process and shall be to the requirements of ISO 630 (minimum yield strength 255 N/mm²). The steel shall be free from blisters, scales, laminations and other defects. Steel sections shall preferably be British Standard or metric standard sections chosen with a view to avoiding delays in obtaining material.

All members shall be cut to jig and all holes shall be drilled or punched to jig. All parts shall be carefully cut and holes accurately located so that when the members are in position the holes will be truly opposite to each other before being bolted up. Drifting or reaming of holes will not be allowed.

Built members shall, when finished, be true and free from all kinks, twists and open joints, and the material shall not be defective or strained in anyway.

If the structures are fabricated or galvanized by subcontractors, the Successful bidder shall, if required by the Engg Incharge (Divisional Engr.), provide resident inspector at the works of each sub-contractor during the time that the steel work is being fabricated or galvanized.

All bolts and screwed rods shall be galvanized, including the threaded portions; all nuts shall be galvanized with the exception of the threads, which shall be oiled.

Except where specified to the contrary, all iron and steel used in the construction of the Contract works shall be galvanized after all sawing, shearing, drilling, punching, filing, bending and machining are completed.

Galvanising of all material shall be in accordance with the requirements of this Specification. The preparation for galvanizing and the galvanizing itself shall not adversely affect the mechanical properties of the coated material.

Sherardizing or other similar process shall not be used.

2. SUPPORT STRUCTURES OF SWITCHYARD:

2.1 General:

The scope of works covers design, fabrication, proto -assembly, supply and erection of galvanized steel structure for portals (columns, girders), lightning masts and equipment support structures.

Portals (columns, girders), lightning masts, and equipment support structures shall be lattice type structures fabricated from structural steel conforming to IS 226/2062. The design of all support structures for 220kV and 33kV equipment. The column and beam and lightning cum lighting mast of 220 KV side shall be of lattice type. All the structural materials are within the scope of the Successful bidder. However approval of the Engg. Incharge (Divisional Engr.) should be obtained for the same before commencement of detailed design.

It is the intent of the Owner to provide structures which allow inter changeability of equipment at alter stage. Keeping this in view, the height of all the structures must be maintained as per approved drawings. It is stressed that the Contractor has to provide minimum steel sections as per the standard drawings. However, if a higher section is required from design point of view the same shall be acceptable. Additional structures called stools shall be connected to the equipment and the bottom of the stool shall be connected to the support structure where required.

The scope shall include the supply of all types of bolts, nuts, hangers, shackles, clamps, anti climbing devices, bird guards, climbing systems, inserts in concrete, gusset plates, equipment mounting bolts, structure earthing bolts, foundation bolts, spring washers, fixing plates, angles and bolts for structure mounted or ground mounted marshalling boxes (ACDC marshalling box and equipment control cabinets), and any other items as required to complete the works.

The connection of all structures to their foundations shall be by base plates and embedded anchor and foundation bolts. All steel structures and anchor or foundation bolts shall be fully galvanised. The weight of the zinc coating shall in accordance with this Specification. One additional nut shall be provided below the base plate which may be used for the purpose of levelling.

2.2 Design requirements:

The minimum bolt diameter shall be 16 mm.

In order to facilitate inspection and maintenance, the structures shall be provided with climbing devices. Each substation gantry structure shall be provided with step bolts not less than 16mm diameter and 175mm long spaced not more than 450mm apart, staggered on faces of one leg extending from about 2.5 meters above ground level to the top of the tower. The step bolts shall conform to IS 10238. Ladders on lightning masts and other tall structures shall be provided with safety guards.

All structures shall be designed for the worst combination of dead loads, live loads, wind loads as per code IS 802, seismic forces as per code IS 1893, loads due to deviation of conductor, load due to unbalanced tension in conductor, torsion al load due to unbalanced vertical and horizontal forces, erection loads, short circuit forces including 'snatch' in the case of bundled conductors etc. Short circuit forces shall be calculated considering a fault level of 50kA. IEC 865 and CIGRE Guide No. 7 may be followed to estimate the various forces of conductor for structural design.

Substation gantry structures shall be designed in accordance with IS 802 for the three conditions i.e. normal conditions, three conductors on one side broken, and broken wire condition and short circuit force. The design of all structures shall be based on the condition where stringing is done

only on one side i.e. all the three (phase) conductors broken on the other side.

A factor of safety of 2.0 under normal and broken wire conditions and 1.5 under combined short circuit and broken wire conditions shall be considered for the design of switch yard structures. For purpose of design 110% of static tension pull and transverse reaction on the gantries as calculated for each span shall be considered.

Vertical load of half the span of conductors/string and the earth wires on either side of the beam shall be taken into account for the purpose of design. The weight of a man with tools shall be considered as 150kg for the design of structures.

Torsional effect on towers and beams due to unbalanced forces may be taken care of as per American Code DS-10.

Terminal line take off gantries shall be designed for a minimum conductor tension of two metric tons per phase for 220kV. The design of these terminal gantries shall also be checked considering 30 degree horizontal and 15 degree vertical deviation of conductor. The transmission line conductors would be either single ACSR conductor per phase on AC side for 220kV.

The gird shall be connected with lattice columns by bolted joints.

All lattice supports used for supporting equipment shall be designed for the worst combination of dead loads, erection load, wind load, seismic forces, short circuit forces and operating forces acting on the equipment and associated bus bars as per IS 806 and IS 1161. Minimum sections for 220kV and 33kV structures shall be as per standard drawings approved by the Engg. Incharge (Divisional Engr.). However, the Contractor can increase the sections if required. The height of the structures shall be as per standard drawings.

If lighting fittings are proposed to be fixed on gantries or towers, the proper loading for these shall be considered in the design. Holes for fixing the brackets for lighting fittings should be provided wherever required.

Foundation bolts and stubs shall be designed for the loads for which the structures are designed.

Lightning masts shall be designed as per IS 802 for diagonal wind condition for a height of 47.5 m for lattice structures and 2.5m for MS pipe with conical head at top.

Lightning masts shall be provided with a structural steel ladder within its base up to a height of 25 metres. The ladder shall be provided with protection rings. Two platforms shall be provided one each at 12.5m and 25m height for mounting of lighting fittings. The platforms shall also have protection railing.

2.3 Design drawings, bill of materials and documents:

The fabrication drawings to be prepared and furnished by the Successful bidder shall be based on the design approved by the Engg. Incharge (Divisional Engr.). These fabrications drawings shall indicate complete details of fabrication and erection including all erection splicing details and typical fabrication splicing details, lacing details, weld sizes and lengths, bill of materials in the proforma approved by the Engg. Incharge (Divisional Engr.), bolt details and all customary details in accordance with standard structural engineering practice whether or not given by the Successful bidder.

Fabrication work shall start only after the final approval of the design and fabrication drawings is accorded by the Engg. Incharge (Divisional Engr.).

Such approval shall, however, not relieve the Successful bidder of his responsibility for the safety of the structure and good connections. Any loss or damage occurring due to defective fabrication, design, or workmanship shall be borne by the Successful bidder.

2.4 Fabrication of steel:

The Successful bidder shall be all the expenditure at all stages on account of loading and unloading, transportation and other miscellaneous expenses and losses and damages for all materials up to the fabrication yard/shop and thereafter to the erection site including all other expenses till the erection of work has been completed and accepted. His unit rates shall be deemed to be inclusive of all such incidental expenses and no extra shall be payable on any account in this regard.

The fabrication and erection works shall be carried out generally in accordance with IS802. A reference however may be made to IS800, in case of non-stipulation of some particular provision in IS802. All materials shall be completely shop fabricated and finished with proper connection material and erection marks for ready assembly in the field.

2.5 Assembly:

2.5.1 General:

The component parts shall be assembled in such a manner that they are neither twisted nor otherwise damaged and shall be so prepared that the specified camber, if any, is provided. In order to minimized is torsion in members the component parts shall be positioned by using clamps, clips, dogs, jigs and other suitable means. Fasteners (bolts and welds) shall be placed in a balanced pattern if the individual components are to be bolted, paralleled and tapered.

Sample towers, beams and lightning mast shall be trial assembled keeping in view the actual site conditions, be for erection in the fabrication shop and shall be inspected and approved by Engg. Incharge (Divisional Engr.) before mass fabrication. Necessary erection marks shall be made on these components in the shop before disassembly and dispatching.

2.5.2 Bolting:

Every bolt shall be provided with a washer under the nut so that no part of the threaded portion of the bolt is within the thickness of the parts bolted together.

- All steel items, bolts, nuts and washers shall be hot dip galvanized.
- 2.0% extra nuts and bolts shall be supplied for erection.

2.5.3 Welding:

The works shall be done in accordance with the General Technical Clauses (TS-GTC) and as per approved fabrication drawing which shall clearly indicate various details such as joints to be welded, type of weld, length and size of weld, and whether shop or site welded. Symbols for welding on erection and shop drawings shall be according to IS 813. Efforts shall be made to reduce site weldings as to avoid improper welding due to constructional difficulties.

Those welds which are considered to be critical to the design and the integrity of the construction of the structure shall be subject to radiographic inspection.

The Successful bidder shall carry out non-destructive testing of all butt welds subject to tensile stresses. Testing shall be carried out in the fabrication shop or on site as the case maybe.

Unless otherwise approved, non-destructive testing shall be by radiographic examination.

2.6 Foundation bolts:

Foundation bolts for the towers and equipment supporting structures and elsewhere shall be embedded in first stage concrete while the foundation is cast. The Successful bidder shall ensure the proper alignment of these bolts to match the holes in the base plate.

The Successful bidder shall be responsible for the correct alignment and levelling of all steel work on site to ensure that the towers and structures are plumb.

All foundation bolts for all structures and supports are to be supplied by the Successful bidder.

All foundation bolts shall be fully galvanized in accordance with the General Technical Clauses of this specification.

The Successful bidder shall provide templates for all stanchion bolt spacing. Holding down bolts, assemblies, templates, tubes and washers shall be delivered to the site in sufficient time to position and build the min to the foundations. Boxing out for bolts shall not be permitted. The projection of threaded portions of bolts above the foundation level shall be adequate to properly secure the nuts.

2.7 Stub setting:

Stub for towers and lightning mast shall be set in such a manner that the distance between the stubs and the realignment and slope shall be exactly as shown in the fabrication drawings.

2.8 Stability of structure:

The Successful bidder shall be responsible for the stability of the structure at all stage so fits erection at site and shall take all necessary measures by the additions of temporary bracing's and guying to ensure adequate resistance to wind and also to loads due to erection equipment and their operations.

2.9 Grouting:

The method of grouting the column bases shall be subject to approval of Engg. Incharge (Divisional Engr.) and shall be such as to ensure a complete uniformity of contact over the whole area of the steel base. The Successful bidder will be fully responsible for the grouting operations. The mix for the grouting shall contain one part of cement and two parts of coarse sand. Non shrinkage admixtures of approved quality and of standard make shall also be added inadequate proportion as specified by the manufacturers of the admixtures.

2.10 Galvanizing:

All structural steel works shall be galvanized after fabrication in accordance with this Specification. The galvanizing of structures having length not exceeding 6m for lattice type, and 5m along with base plate size of 750x750mm for other type, shall be made in one dip only.

The Successful bidder shall be required to make arrangements for frequent inspection by the Engg. Incharge (Divisional Engr.) as well as continuous inspection by a resident representative of the Engg. Incharge (Divisional Engr.), if so desired for this fabrication work.

2.11 Painting:

Where members of steel structures are required to be painted it shall meet the requirements as specified in relevant sections of this Specification.

2.12 The preparation, protection and painting systems selected for ferrous surfaces provided inside the switchyard shall provide a life to first maintenance of 20 years and for doors, windows, louvres etc., it shall provide life to first maintenance of 10 years. Finish colour will be selected as per relevant sections of this Specification.

3. INSPECTION BEFORE DESPATCH:

Each part of the fabricated steel work shall be inspected for correctness of physical parameters, welding, joints, erection marks etc., before it is dispatched to the erection site. In any case the Successful bidder shall be fully responsible for correctness, quality, adequacy and completeness of structures being erected under the scope of this contract.

3.1 Testing and inspection:

The Successful bidder shall give full access to the Engg. Incharge (Divisional Engr.) at all times to the place of fabrication and storage for the purpose of inspection and testing. Mill test certificates relating to the material procured by the Successful bidder for works shall be forwarded to the Engg. Incharge (Divisional Engr.).

When so instructed by the Engg Incharge (Divisional Engr.), the Successful bidder shall provide samples of the steel to be used in the works for tests to be carried out at an independent laboratory approved by the Engg. Incharge (Divisional Engr.). The cost of these independent tests shall be paid by the Successful bidder.

Should the works or any part thereof fail to pass any test or in the opinion of the Engg. Incharge (Divisional Engr.) fail to comply with the specification, the Successful bidder shall immediately take such action as is necessary to ensure that the works comply with the specification at no extra cost to the Owner.

All defective material and workmanship will be rejected and shall be replaced and reconstructed at the Successful bidder's expense.

No splice welding of members between connections shall be permitted without the prior approval of the Engg. Incharge (Divisional Engr.).

3.2 Dispatch, handling and storage:

All bolts, nuts, washers, plates etc. shall be transported to site in properly marked and sealed containers, suitably protected to prevent damage during transportation.

3.3 Test certificate:

Copies of all test certificate relating to material procured by the Successful bidder for the works shall be forwarded to the Engg. Incharge (Divisional Engr.).

4. ERECTION:

The Successful bidder should arrange his own erection plant and equipment, welding sets, tools and tackles, scaffolding, trestles equipment etc. and any other accessories and ancillaries required for the work.

Finished structures shall be plumb, level and true to dimensions, within the tolerances specified.

4.1 Safety precautions:

The Successful bidder shall strictly follow at all stages of fabrication, transportation and erection of steel structures, raw materials and other tools and tackles, the stipulations contained in Indian Standard Code for erection for structural steel work, IS 7205.

4.2 Fire protection to steel work:

The fire protection to steelwork shall be an approved luminescent paint, spray or board system

to give two hours fire protection when tested. Fire protection shall only be required in the immediate vicinity of potential fire sources.

If applicable, fire protection coatings shall be sprayed or painted onto previously primed steel work. Application to be made in strict accordance with product loading rates for base coat and top sealer specified for two hours fire resistance in manufacturers product application notes. Suitable mesh reinforcement shall be incorporated to prevent loss of insulation when subject to mechanical damage.

The coatings shall be applied by a specialist applicator strictly in accordance with the product manufacturers' recommendations. The whole of the fire protection proposals and application shall be in accordance with the current Building Regulations and to the satisfaction of the Local Authority and the Fire Authority.

Surfaces which are to receive a fire protective coating shall be delivered to site with travel coatings applied and shall be suitably protected until immediately prior to the fire protective coatings or casings being applied. The latter shall be applied as late as possible in the construction programme subject to the trades and operations. Primer and travel coat shall be compatible with the fire protection coating.

5. WIDTH AND HEIGHT OF THE BUS AT SUB-STATION:

VOLTAGE LEVEL	BAY WIDTH	BOTTOM BUS HEIGHT	TOP BUS HEIGHT
33 kV	5.5 MTRS	5.5 MTRS	9.5 MTRS
220 kV	18 MTRS	10.5 MTRS	16 MTRS

PART-30
ERECTION SPECIFICATION

ERECTION SPECIFICATION

1.0 GENERAL

This specification covers the supply handling and storage of material at site, installation, erection, testing and commissioning of all equipment/sub systems in 220/33kV TFL GIS, Talcher, Odisha. The Successful bidder shall receive and store all the equipment at site on behalf of the owner in storage yard/stores/sheds and transport the material to erection site and shall carryout erection, testing and commissioning of all equipment and accessory items as required. The Successful bidder shall be required to complete the work as per the completion schedule as defined in the contract.

This Section covers the Description of the following Items: -

A. Erection/Testing and Commissioning of:

- 220kV Gas insulated switchgear
- 220kV Outdoor LILO Equipment
- 220kV Cable feeding equipment including cable sealing end
- 20 MVA, 220/33kV Power transformer
- 33kV Outdoor Switchyard Equipment
- Station Auxiliary transformer
- Auxiliary power supply system including AC Distribution board
- Battery, Battery charger and D.C. Distribution Board
- Illumination system in control room and switchyard area
- LV cables and associated cable support system
- Protection and control relay panels.
- Substation Automation system including GPS clocks and antennas.
- Fibre optic cabling and its associated cable support systems.
- Fire protection and Fire alarm system
- Heat Ventilation and Air conditioning system.
- ACSR Conductor
- Galvanized Steel Earthwire
- Aluminium Tubular Bus Bars
- Spacers
- Bus Post Insulators

- Earthing and Earthing Materials
- Lightning Protection Materials
- Miscellaneous items.

B. UNLOADING, HANDLING & STORAGE OF ALL EQUIPMENT & MATERIALS.

C. ERECTION OF ALL ITEMS

1.1 ERECTION CONDITIONS:

General:

The following shall supplement the conditions already contained in the other parts of these specifications and documents and shall govern that portion of the work on this Contract to be performed at Site.

Regulation of local authorities and statutes:

The Contractor shall comply with all the rules and regulations of local authorities during the performance of his field activities. He shall also comply with the Minimum Wages Act, 1948 and the payment of Wages Act (both of the Government of India and Govt of Orissa) and the rules made thereunder in respect of any employee or workman employed or engaged by him or his Sub-Contractor.

All registration and statutory inspection fees, if any, in respect of his work pursuant to this Contract shall be to the account of the Contractor. However, any registration, statutory inspection fees lawfully payable under the provisions of the statutory laws and its amendments from time to time during erection in respect of the substation ultimately to be owned by the Employer, shall be to the account of the Employer. Should any such inspection or registration need to be re-arranged due to the fault of the Contractor or his Sub-Contractor, the additional fees to such inspection and/or registration shall be borne by the Contractor.

The Contractor shall ensure that he obtains, from the Government of Orissa, an Electrical Contractor's Licence and a supervisory certificate of the appropriate grade to allow him to execute the electrical works included in the Contract. The Contractor shall ensure that all workmen possess Workman Permits, issued by the Government of Orissa, for engagement in the Contract Works.

Inspection, testing and inspection certificates:

The provisions of the General Conditions of Contract shall also be applicable to the erection portion of the Works. The Engg. Incharge (Divisional Engr.) shall have the right to re-inspect

any equipment though previously inspected approved by him at the Contractor's works, before and after the same are erected at Site.

Contractor's field operation:

General:

The Contractor shall inform the Engg. Incharge (Divisional Engr.) in advance of field activity plans and schedules for carrying-out each part of the works. Any review of such plans or schedules or methods of work by the Engg. Incharge (Divisional Engr.) shall not relieve the Contractor of any of his responsibilities towards the field activities. Such reviews shall not be considered as an assumption of any risk or liability by the Employer or any of his representatives, and no claim of the Contractor will be entertained because of the failure or inefficiency of any such plan or schedule or method of work reviewed. The Contractor shall be solely responsible for the safety, adequacy and efficiency of plant and equipment and his erection methods.

Progress Report:

Progress reports shall be provided by the Contractor to the Engg. Incharge (Divisional Engr.) in accordance with the relevant parts of this specification. Appropriate photographs shall accompany the monthly progress reports.

Facilities to be provided by the contractor:

Unloading:

Contractor shall make his own arrangement for unloading the equipment at site.

Tools, tackle and scaffoldings:

The Contractor shall provide all the construction equipment tools, tackle and scaffoldings required for offloading, storage, pre-assembly, erection, testing and commissioning of the equipment covered under the Contract. He shall submit a list of all such materials to the Engg. Incharge (Divisional Engr.) before the commencement of pre-assembly at Site. These tools and tackles shall not be removed from the Site without the written permission of the Engg. Incharge (Divisional Engr.).

First-Aid and general hygiene:

The Contractor shall provide necessary first-aid facilities for all his employees, representatives and workmen working at the site. At all times at least ten percent of all Contractors personnel assigned to the worksite shall be shall be trained in administering first-aid.

The labour colony, offices and residential areas of the Contractor's employees and workmen shall be kept clean and neat to the entire satisfaction of the Engg. Incharge (Divisional

Engr.). Proper sanitary arrangements shall be provided by the Contractor in work-areas, offices and residential areas of the Contractor.

Waste oil shall be disposed of in a manner acceptable to the Engg. Incharge (Divisional Engr.). Under no circumstances shall waste oil be dumped into uncontrolled drains.

Security:

The Contractor shall have total responsibility for all equipment and material in his custody, stored, loose, semi-assembled and/or erected by him at Site. The Contractor shall make suitable security arrangements including employment of security personnel to ensure the protection of all materials, equipment and works from theft, fire, pilferage and any other damages and loss.

Materials handling and storage:

All the equipment furnished under the Contract and arriving at Site shall be promptly received, unloaded and transported and stored in the stores by the Contractor.

Contractor shall be responsible for examining the complete shipment and notifying the Engg. Incharge (Divisional Engr.) immediately of any damage, shortage, discrepancy etc. for the purpose of Engg. Incharge (Divisional Engr.)'s information only. The Contractor shall submit to the Engg. Incharge (Divisional Engr.) every week a report detailing all the receipts during the weeks. However, the Contractor shall be solely responsible for any shortages or damages during transit, handling, storage and erection of the equipment at Site. Any demurrage, wharfage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor.

The Contractor shall maintain an accurate and exhaustive record detailing all equipment received by him for the purpose of erection and keep such record open for the inspection of the Engg. Incharge (Divisional Engr.).

All equipment shall be handled carefully to prevent any damage or loss. All equipment stored shall be properly protected to prevent damage. Equipment from the store shall be moved to the actual location at an appropriate time so as to avoid damage of such equipment at Site.

All the materials stored in the open or dusty location shall be covered with suitable weather-proof and flameproof covering material.

The Contractor shall be responsible for making suitable indoor facilities for the storage of all equipment which requires to be kept indoors.

2.0 STANDARDS:

The supply, erection, testing and commissioning of equipment covered by this specification shall comply with the latest editions of the relevant standards and code of practice. Some of the applicable standards are given below:

	IS: 731	Porcelain insulators for overhead power lines with a nominal voltage greater than 1000 V
	IS: 398 Part 1	Aluminium Conductors for overhead transmission purposes Specification Part 1 Aluminium stranded conductors
	IS: 2121	Conductors and earth wire accessories for overhead power lines: Part 1 Armour rods, binding wires and tapes for conductors
	IS: 2705	Current transformers: Part 1 General requirements
	IS: 3156 Part 1	Voltage transformers: Part 1 General requirements
	IS: 3070 Part 3	Lightning Arresters for alternating current systems - Part 3 : Metal oxide lightning arresters without gaps
	IS: 3639	Fittings and accessories for Power Transformers
	IS: 2026 Part 1	Power transformers: Part 1 General
	IS: 10028 Part 1	Code of practice for selection, Installation and maintenance of transformers - Part 1 : Selection
	IS: 10028 Part 2	Code of practice for selection, installation and maintenance of transformers: Part 2: Installation
	IS: 10028 Part 3	Code of practice for selection, installation and maintenance of transformers: Part 3: Maintenance
i)	IS: 13118	High-Voltage Alternating-Current Circuit-Breakers
ii)	IS: 9921 Part 1	Alternating Current disconnectors (Isolators) and earthing switches for voltages above 1 000 V - Part I : General and definitions
iii)	IS: 9921 Part 2	Alternating current disconnectors (isolators) and earthing

		switches for voltages above 1000 V: Part 2 Rating
iv)	IS: 9921 Part 3	Alternating current disconnectors (Isolators) and earthing switches for voltages above 1000 V - Part III : Design and construction
v)	IS: 9921 Part 4	Alternating current disconnectors (isolators) and Earthing Switches for voltages above 1000 V - Part 4 : Type tests and routine tests
vi)	IS: 9921 Part 5	Alternating current disconnectors (Isolators) and earthing switches for voltages above 1 000 v - Part 5 : Information to be given with tenders, enquiries and orders
vii)	IS: 800	General construction in steel - Code of practice
viii)	IS: 3043	Code of practice for earthing
ix)	IS: 2309	Code of practice for the protection of buildings and allied structures against lightning
x)	IS: 5216 Part 1	Recommendations on safety procedures and practices in electrical work - Part I : General
xi)	IS: 5216 Part 2	Recommendation on safety procedures and practices in electrical work - Part II : Life saving techniques
xii)	IS: 2062	Hot rolled medium and high tensile structural steel
xiii)	IS: 5624	Foundation bolts
xiv)	IEEE 80-2013	Guide for safety in AC substation grounding
xv)	OSID-STD-173	Fire Prevention and protection system for Electrical Installation.
xvi)	OSID-RP-149	Design Aspects for Safety in Electrical system.

3.0 GENERAL INSTRUCTIONS:

- 1.1.1 Transportation and unloading of the substation material and equipment at the location shall be done in a safe manner so that they are not damaged or misplaced.

- 1.1.2 All the material and equipment shall be checked as per Bill of Material (BOM).
- 1.1.3 All support insulators, circuit breaker poles, Transformer bushings and other fragile equipment shall preferably be handled carefully with cranes having suitable boom length and handling capacity.
- 1.1.4 Sling ropes, etc. should be of sufficient strength to take the load of the equipment to be erected. They should be checked for breakages of strands before being used for the erection of equipments.
- 1.1.5 The slings should be of sufficient length to avoid any damage to insulator or other fragile equipments due to excessive swing, scratching by sling ropes, etc.
- 1.1.6 Mulmul cloth shall be used for cleaning the inside and outside of hollow insulators.
- 1.1.7 Erection of equipment shall be carried out as per and in the manner prescribed in the erection, testing and commissioning manual / instructions procedures of the manufacturer.
- 1.1.8 The services of the manufacturer's Engineer, wherever necessary, shall be utilized for erection, testing and commissioning of substation equipment.
- 1.1.9 Whenever the work is required to be got done at the existing GSS where the adjacent portions may be charged, effective earthing must be ensured for safety against induced voltages so that work can be carried out without any danger / hazard to the workmen.
- 1.1.10 After completion of the erection work, all surplus material including bolts and nuts, templates, etc. shall be returned to the store. All unusable cut lengths of material such as conductor, earth wire, etc. shall not be treated as wastage and shall also be deposited in the store.
- 1.1.11 Test reports for pre-commissioning and commissioning test carried out shall be submitted as per approved proforma for each Equipment.

4.0 ISOLATOR:-

- i) Level the already erected structure(s) and carry out minor fabrication works, if required, for erection of the Isolator and operating mechanism(s).
- ii) Erect the 2 nos. base frames of individual phases on the structure(s).
- iii) Carry out levelling and cantering of the base frames.
- iv) Fix the link pipes on the rotating parts of the base frames of the individual phases.
- v) Clean and assemble the insulator / insulator stack, as applicable. For centre break isolators, there will be six insulators / insulator stacks whereas for double break Isolators, the quantity will be nine.

- vi) Fit the fixed contacts of earth blades in case of Isolator with Earth Switch.
- vii) Fix the arcing horns (make before & open after the main contacts) or corona rings, as applicable.
- viii) Erect the above assemblies on the rotating parts of the base frames.
- ix) Carry out adjustment / alignment of individual phases for smooth opening and closing and proper making of contacts.
- x) Fit the inter - phase connecting pipes between the rotating parts of the base frames of the individual phases, including fixing of hardware for interlocking with earth switch wherever provided.
- xi) Fit the operating mechanism box for the Isolator.
- xii) Fit the main operating down pipe to operating mechanism for the Isolator.
- xiii) Check the operation and final adjustment / alignment of all the three phases of main Isolator for smooth, synchronized and complete operation as one unit.
- xiv) Adjust the mechanical end stoppers on the base channel for both the closed and open positions.
- xv) Fit the terminal connectors on the Isolator.

5.0 CURRENT TRANSFORMERS:

GENERAL INSTRUCTIONS:

- i) While erecting the Current Transformers, it must be ensured that the P1 terminal is towards the main bus side. For more details refer Protection and metering SLD.
- ii) The secondary windings are rated for 1 Amp.

ERECTION:

- i) Carry out levelling of already erected structure(s) and minor fabrication work, if required, for erection of the Current Transformer.
- ii) Clean the insulator of the Current Transformer.
- iii) Measure the IR values of primary terminals to earth with 5 kV Megger.
- iv) Erect the Current Transformer on the structure.
- v) Fit the terminal connectors on the Current Transformer.

6.0 VOLTAGE TRANSFORMERS (VT):

GENERAL INSTRUCTIONS:

- i) Voltage Transformers (VT) are used for protection and metering.
- ii) The different cores of the secondary winding of the VT are used for different applications as per SLD. The secondary windings are rated for $110 / \sqrt{3}$ Volts.
- iii) A ferrule 'E' is generally used as prefix of the ferrule markings for indicating the wires of different cores of the VTs.
- iv) The VT or its individual units should be kept shorted and earthed to prevent shock from accumulated charge. This shorting may be temporarily removed for testing. The shorting should be finally removed before energizing the VT.

ERECTION:

- i) Carry out Levelling of already erected structure(s) and minor fabrication work, if required, for erection of the Voltage Transformers.
- ii) Clean the insulators of the VT.
- iii) Assemble the different units of the same serial number of the VT, if applicable.
- iv) Measure the IR values of primary terminal to earth with 5 kV Megger.
- v) Erect the Voltage Transformer on the structure.
- vi) Fit the covers on the joints between different units of the VT, if applicable.
- vii) Fit the terminal connectors on the VT.

7.0 LIGHTNING ARRESTERS:

GENERAL INSTRUCTIONS:

- i) The serial number of all the units of a multi – unit Lightning Arrester (LA) should be the same.
- ii) The units of a multi – unit Lightning Arrester should be assembled in the sequence shown on the rating plate of the LA or in the catalogue of the manufacturer.
- iii) The insulated base unit should be erected in case of Lightning Arresters provided with surge monitors.
- iv) The installation of the Lightning Arresters should be such that the direction of the open end of the explosion release vent (at top & bottom) is away from adjacent expensive equipment such as transformers.

Erection of LAs of 216kV Class:

- i) Level the already erected supporting structure(s) and carry out minor fabrication work there on for erection of the Lightning Arresters and surge monitors, as required.
- ii) Clean the insulators of the Lightning Arresters.
- iii) Assemble the different units of the same serial number of the Lightning Arresters, if applicable. Also, carry out fitting of the corona rings between different units, if provided.
- iv) Erect the Lightning Arresters on the already erected and levelled supporting structure(s).
- v) Fit the Surge Monitor on the structure and connect it to the lowest unit of the Lightning Arrester above the base insulator.
- vi) Fit the corona / grading ring on the top of the Lightning Arrester, if provided.
- vii) Fit the terminal connectors on the Lightning Arresters.

8.0 CONTROL & RELAY PANELS:**GENERAL INSTRUCTIONS:**

- i) Check and ensure that the Control & Relay Panels being installed are meeting the requirements of DC control voltage (220V) and CT secondary rating (1A).
- ii) Check that there is no physical damage to the relays and other equipment installed in the C&R Panel.
- iii) All Protection schemes should be tested / got tested as per their schematic diagrams.

ERECTION AND INSTALLATION:

- i) Place the panels at their designated locations on the trenches in the Control Room as per layout.
- ii) Fix or bolt the panels (as per requirement of installation of the panels) on the channel/M. S. Angle fitted on the top of the walls of the trench or on the base frame, as provided, in the Control Room.
- iii) Level the panels and check their verticality.
- iv) In the case of Duplex type of panels, connect the control panel to the relay panel across the corridor using the fittings provided with the panels. Also fit the covers for the corridor portion.
- v) Where a number of panels are to be placed adjacent to each other to form a Board or where a panel is to be placed adjacent to an existing Panel / Board, these shall be bolted together. There shall be no gap between panels which are placed adjacent to each other.

- vi) Connect the Bus wiring / interconnecting wiring between the control & relay panels of the Duplex type. Also connect the similar wiring between control panel to control panel and / or relay panel to relay panel where a Board formation is made or where panels are connected to an existing Board / panel as per their relevant schematic drawings.

9.0 LT PANELS:

GENERAL INSTRUCTIONS:

- i) The AC supply to the various circuits panels sub stations are connected as per ACDB drawings.

ERECTION AND INSTALLATION:

- i) Check the LT Panel for any mechanical damage before installation.
- ii) Measure insulation resistance of panel wiring and the LT Bus Bar (phase to phase and phase to earth) with 500 V Megger before connecting any cable.
- iii) Place the LT Panel at its designated location in the control room as per layout.
- iv) Fix / bolt the LT Panel on the trench provided in the floor of the control room.
- v) Lay the power for the proposed LT Panel. Strip off the insulation of the power cable ends and of the wires. Crimp on aluminum terminal lugs / thimbles of suitable size at both the ends.
- vi) First connect the cable to the LT Panel.
- vii) Then connect the cables to the LT terminals of the Existing LT panel (HPCL Plant)
- viii) Lay the cables from the LT Panel to the respective bay marshalling kiosks / C & R panels transformer, etc. Strip off the insulation of the cable ends and of the wires. Crimp on terminal lugs / thimbles of suitable size at both the ends.
- ix) Connect one end of the individual cables to the terminals in the terminal blocks corresponding to the designated switch fuse unit in the LT Panel. Connect the other end of the cables in the respective equipment.
- x) Lay the cable from the DC Panel to the LT Panel for DC supply. Strip off the insulation of the cable ends and of the wires. Crimp on terminal lugs / thimbles of suitable size at both the ends. Connect the cable at both the ends.

10.0 BATTERY (Plante & VRLA):

Important recommendations:

- i) Never allow an exposed flame or spark near the battery, particularly while charging.
- ii) Never smoke while performing any operation on the battery.

- iii) For protection, wear rubber gloves, long sleeves and appropriate splash goggles or face shield.
- iv) The electrolyte is harmful to skin and eyes. In the event of contact with skin or eyes, wash immediately with plenty of water. If eyes are affected flush with water, and obtain immediate medical attention
- v) Use insulated tools.
- vi) Avoid static electricity and take measures for protection against electric shocks.
- vii) Discharge any possible static electricity from clothing and/or tools by touching on earth connected part “ground” before working on the battery.

Installation:

Location:

- i) Install the battery in control room as per arrangement shown in the approved layout as per manufacturers’ instructions.
- ii) It is recommended that at least 200 mm be allowed above cell tops, to ensure easy access during inspection and water replenishment, and that enough space is allowed between cabinet walls and the battery to avoid any risk of short-circuits. Flip- top vents may be turned through 180° to achieve the most convenient position for water replenishment.

Ventilation:

If it is requires to establish that the ventilation of the battery room is adequate, then it is necessary to calculate the rate of evolution of hydrogen to ensure that the concentration of hydrogen gas in the room is kept within safe limits.

Mounting:

Verify that the cells are correctly interconnected with the appropriate polarity. The battery connection to load should be with nickel-plated cable lugs. Recommended torques for connecting nuts are:

- M 10 = 10 ± 2 N.m
- M 12 = 15 ± 2 N.m

The connectors and terminal nuts should be corrosion protected by coating with a film of neutral Vaseline.

Remove the transport seals and close the vents.

11.0 DCDB PANELS:

GENERAL INSTRUCTIONS:

- i) The DC supply to the various circuits / panels at 220kV & 33kV sub stations are connected from independent MCB's. The distribution of the MCB's details refer DCDB drawing
- ii) Measure insulation resistance of panel wiring with 500V Megger before connecting any cable.

ERECTION AND INSTALLATION:

- i) Check the DC Panel for any mechanical damage before installation.
- ii) Place the DC Panel at its designated location in the control room as per layout.
- iii) Fix / bolt the DC Panel on the trench provided in the floor of the control room or on the base frame if provided.
- iv) Lay the cables from the DC Panel to the battery charger. Strip off the insulation of the cable ends and of the wires. Crimp on terminal lugs / thimbles of suitable size at both the ends.
- v) First connect the cables to the positive and the negative terminals of the DC Panel.
- vi) Then connect the cables to the positive and the negative terminals of the battery charger.
- vii) Lay the cables from the DC Panel to the respective C & R Panels / equipment. Strip off the insulation of the cable ends and of the wires. Crimp on terminal lugs / thimbles of suitable size at both the ends.
- viii) Connect one end of the individual cables to the terminals in the terminal blocks corresponding to the designated MCB's in DC Panel. Connect the other end of the cables in the respective C & R panels.
- ix) Lay the cable from the LT Panel to the DC Panel for AC supply. Strip off the insulation of the cable ends and of the wires. Crimp on terminal lugs / thimbles of suitable size at both the ends. Connect the cable at both the ends.

SWITCHYARD ERECTION (TFL SS)

CLAUSE No.	DESCRIPTION
12.0	ACSR CONDUCTOR
13.0	GALVANISED STEEL EARTH WIRE
14.0	EARTHING CONDUCTOR
15.0	EARTHING
16.0	LIGHTNING PROTECTION
17.0	STORAGE
18.0	CABLING MATERIAL
19.0	DIRECTLY BURIED CABLES
20.0	INSTALLATION OF CABLES
21.0	JUNCTION BOX
22.0	TESTING AND COMMISSIONING
ANNEXURE - A	TESTING PROCEDURE FOR ACSR CONDUCTOR
ANNEXURE - B	TESTING PROCEDURE FOR GALVANISED STEEL EARTH WIRE
ANNEXURE - C	CORONA AND RADIO INTERFERENCE VOLTAGE (RIV) TEST
ANNEXURE - D	STANDARD TECHNICAL DATA SHEETS FOR AAC / ACSR CONDUCTOR, GS EARTH WIRE AND ALUMINIUM TUBE
	GENERAL INSTRUCTIONS FOR EARTHING

12.0 ACSR CONDUCTOR

DETAILS OF CONDUCTOR:

The Conductor shall conform to IS: 398 (Part - V) – 1992 except where otherwise specified herein.

The details of the Conductor are tabulated below: -

ACSR MOOSE CONDUCTOR:

Sr. No.	DESCRIPTION	ACSR 'MOOSE'
a	Stranding and Wire Diameter	54 / 3.53 mm Al. + 7 / 3.53 mm Steel
b	Number of Strands	
	Steel Centre	1
	1 st Steel Layer	6
	1 st Aluminium Layer	12
	2 nd Aluminium Layer	18
	3 rd Aluminium Layer	24
c	Sectional Area of Aluminium	528.5 mm ²
d	Total Sectional Area	597. 0 mm ²
e	Overall Diameter	31.77 mm
f	Approximate Weight	2001.5 kg / km
g	Approximate Resistance at 20 °C Ohms per km	0.0548
h	Minimum Ultimate Strength kN	161.2

The details of Aluminium Strand are as follows: -

ACSR MOOSE AND CONDUCTOR:

Sr. No.	DESCRIPTION	ACSR 'MOOSE'
i)	Minimum Breaking Load of Strand before stranding; kN	1.57
ii)	Minimum Breaking Load of Strand after stranding; kN	1.49
iii)	Maximum DC Resistance of Strand ohms / km at 20 °C	2.921

The details of Steel Strand are as follows: -

ACSR MOOSE AND CONDUCTOR:

Sr. No.	DESCRIPTION	ACSR 'MOOSE'
i)	Minimum Breaking Load of Strand before stranding	12.86 kN
ii)	Minimum Breaking Load of Strand after stranding	12.22 kN
iii)	Minimum number of twist to be withstood In Torsion Test when tested on a gauge length of 100 times diameter of wire	18 (before Stranding) 16 (after Stranding)

WORKMANSHIP:

The finished Conductor shall be smooth, compact, uniform and free from all imperfections including spills and splits, die marks, scratches, abrasions, scuff marks, kinks (protrusion of wires), dents, press marks, cut marks, wire cross over, over riding, looseness (wire being dislocated by finger / hand pressure and / or unusual bangle noise on tapping), material inclusions, white rust, powder formation or black spots (on account of reaction with trapped rain water etc) dirt, grit etc.

All the Aluminium and Steel Strands shall be smooth, uniform and free from all imperfections, such as spills and splits, die - marks, scratches, abrasions, and kinks etc after drawing.

The Steel Strands shall be Hot Dip Galvanized and shall have minimum Zinc Coating of 260 gm. / sq. m. after stranding of the uncoated wire surface. The Zinc Coating shall be smooth, continuous and of uniform thickness, free from imperfections and shall withstand minimum three dips after stranding in standard Preece Test. The finished strands and the individual wires shall be of uniform quality and have the same properties and characteristics as prescribed in ASTM designation: B 498 – 74.

The Steel Strands shall be preformed and post formed in order to prevent spreading of strands in the event of cutting of composite core wire. Care shall be taken to avoid damage to galvanization during performing and post forming operation.

JOINTS IN WIRES:

ALUMINIUM WIRES:

No Joints shall be permitted in the individual wires in the **outermost layer** of the finished Conductor. However, Joints in the 12 wire and 18 wire Inner Layers of the Conductor shall be allowed but these Joints shall be made by Cold Pressure Butt Welding and shall be such that no such Joints are within 15.0 metres of each other in the complete stranded Conductor.

STEEL WIRES:

There shall be no joint of any kind in the finished wire entering into the manufacture of the strand. There shall also be no strand joints or strand splices in any length of the completed Stranded Steel Core of the Conductor.

TOLERANCES:

The Manufacturing Tolerances to the extent of the following limits only shall be permitted in the Diameter of individual Aluminium and Steel Strands and Lay - Ratio of the Conductor:

MATERIALS:

ALUMINIUM:

The Aluminium Strands shall be Hard Drawn from Electrolytic Aluminium Rods having purity not less than 99.5 % and a Copper content not exceeding 0.04 %.

STEEL:

The Steel Wire Strands shall be drawn from High Carbon Steel Wire Rods and shall conform to the following Chemical Composition:

ELEMENT	-	% COMPOSITION
Carbon	-	0.50 to 0.85
Manganese	-	0.50 to 1.10
Phosphorous	-	not more than 0.035
Sulphur	-	not more than 0.045
Silicon	-	0.10 to 0.35

ZINC:

The Zinc used for Galvanizing shall be Electrolytic High Grade Zinc of 99.95 % purity. It shall conform to and satisfy all the requirements of IS: 209 – 1979.

STANDARD LENGTH:

The Conductor shall be supplied as required. No Joint shall be allowed within a single Span of Stringing, Jumpers, and Equipment Interconnection.

TESTS:

The following Type, Acceptance and Routine Tests and Tests during Manufacturing shall be carried out on the Conductor: -

TYPE TESTS ON CONDUCTOR:

In accordance with the stipulation of Specification, the following Type Tests Reports of the Conductor shall be submitted for approval of the Owner: -

- a) UTS Test on Stranded Conductor

- b) Corona Extinction Voltage Test (Dry)
- c) Radio Interference Voltage Test (Dry)
- d) D. C. Resistance Test on Stranded Conductor

ACCEPTANCE TESTS:

- a) Visual Check for Joints, Scratches etc and lengths of Conductor
- b) Dimensional Check on Steel and Aluminium Strands
- c) Check for Lay Ratios of various Layers
- d) Galvanizing Test on Steel Strands
- e) Torsion and Elongation Test on Steel Strands
- f) Breaking Load Test on Steel and Aluminium Strands as per IS: 398 (Part V) - 1982
- g) Wrap Test on Steel and Aluminium Strands as per IS: 398 (Part V) - 1982
- h) D. C. Resistance Test on Aluminium Strands as per IS: 398 (Part V) - 1982
- i) UTS Test on Welded Joint of Aluminium Strands

NOTE:

All the above Tests except Test mentioned at (a) shall be carried out on Aluminium and Steel Strands after stranding only.

ROUTINE TESTS:

- a) Check to ensure that the Joints are as per Specification.
- b) Check that there are no cuts, fins etc on the Strands.
- c) All Acceptance Tests as mentioned in Clause 2.7.3 above to be carried out on each coil.

TESTS DURING MANUFACTURE:

- a) Chemical Analysis of Zinc used for Galvanizing
- b) Chemical Analysis of Aluminium used for making Aluminium Strands
- c) Chemical Analysis of Steel used for making Steel Strands

SAMPLE BATCH FOR TYPE TESTING:

The Successful Bidder shall offer Material for selection of samples for Type Testing, only after getting Quality Assurance Plans approved from the Owner. The sample shall be manufactured strictly in accordance with the Quality Assurance Plan approved by Owner.

13.0 GALVANIZED STEEL EARTHWIRE:

DETAILS OF EARTHWIRE:

The Galvanized Steel Earthwire shall generally conform to the Specification of ACSR Core Wire as mentioned in IS: 398 (Part - II) – 1976 except where otherwise specified herein.

The details of the Earthwire are tabulated below:

a	Stranding and Wire Diameter	7 / 3.15 mm	7 / 3.66 mm
b	Number of Strands		
	Steel Core	1	1
	Outer Steel Core	6	6
c	Total Sectional Area	54.6 mm ²	73.65 mm ²
d	Overall Diameter	9.45 mm	10.98 mm
e	Approximate Weight	426 kg / km	583 kg / km
f	Calculated D. C. Resistance at 20 ° C		2.5 ohm / km
g	Minimum Ultimate Tensile Strength	56.98 kN	72.9 kN
h	Direction of Lay of Outer Layer	Right Hand	
i	Modulus of Elasticity	19 x 10 ³ kg / sq. mm.	
j	Co - efficient of Linear Expansion	11.5 x 10 ⁻⁶	
k	Maximum Allowable Temperature	53 ° C	

WORKMANSHIP:

All Steel Strands shall be smooth, uniform, and free from all imperfections, such as spills and splits, die marks, scratches, abrasions, and kinks after drawing and after stranding.

The Finished Material shall have minimum brittleness, as it will be subjected to appreciable vibration while in use.

The Steel Strands shall be Hot Dip Galvanized (and shall have Minimum Zinc Coating of 275 gm. / sq. m.) after stranding of the uncoated wire surface. The Zinc Coating shall be smooth, continuous, of uniform thickness, and free from imperfections and shall withstand three and a half dip after stranding in standard Preece Test. The Steel Wire Rod shall be of such quality and purity that when drawn to the size of the strands specified and coated with Zinc, the

finished strands shall be of uniform quality and have the same properties and characteristics in ASTM designation B 498 - 74.

The Steel Strands shall be preformed and post formed in order to prevent spreading of strands while cutting of composite Earth wire. Care shall be taken to avoid damage to galvanization during performing and post forming operation.

To avoid susceptibility towards wet storage stains (white rust), the Finished Material shall be provided with a protective coating of boiled linseed oil.

JOINTS IN WIRES:

There shall be no joint of any kind in the Finished Steel Wire Strand entering into the manufacture of the Earth wire. There shall be no Strand Joints or Strand Splices in any length of the completed stranded Earth wire.

TOLERANCES:

The Manufacturing Tolerances to the extent of the following limits only shall be permitted in the Diameter of the Individual Steel Strands and Lay Length of the Earth wire:

	7 / 3.15 mm			7 / 3.66 mm		
	STANDARD	MAXIMUM	MINIMUM	STANDARD	MAXIMUM	MINIMUM
Diameter, mm	3.15	3.24	3.12	3.66	3.75	3.57
Lay Length, mm	181	198	165	181	198	165

MATERIALS:

STEEL: The Steel Wire Strands shall be drawn from High Carbon Steel Rods and shall conform to the following requirements as to the Chemical Composition:

ELEMENT	% COMPOSITION
Carbon	Not more than 0.55
Manganese	0.4 to 0.9
Phosphorous	Not more than 0.04
Sulphur	Not more than 0.04
Silicon	0.15 to 0.35

ZINC:

The Zinc used for galvanizing shall be Electrolytic High Grade Zinc of 99.95 % purity. It shall conform to and satisfy all the requirements of IS: 209 - 1979.

STANDARD LENGTH:

The Earth wire shall be supplied in Standard Drum Length of Manufacturer.

TESTS:

The following Type, Routine and Acceptance Tests and Tests during Manufacturing shall be carried out on the Earth wire: -

TYPE TESTS:

In accordance with the stipulation of the Specification, the following Type Tests shall be conducted on the Earth wire: -

- a) UTS Test
- b) DC Resistance Test

ACCEPTANCE TESTS:

- a) Visual Check for Joints, Scratches etc and Length of Earth wire
- b) Dimensional Check
- c) Galvanizing Test
- d) Lay Length check
- e) Torsion Test
- f) Elongation Test
- g) Wrap Test
- h) D. C. Resistance Test as per IS: 398 (Part - III) - 1976
- i) Braking Load Test as per IS: 398 (Part - III) - 1976
- j) Chemical Analysis of Steel as per IS: 398 (Part - III) – 1976

ROUTINE TESTS:

- a) Check that there are no cuts, fins etc on the strands.
- b) Check for correctness of stranding.

TESTS DURING MANUFACTURE:

- a) Chemical Analysis of Zinc used for galvanizing
- b) Chemical Analysis of Steel

SAMPLE BATCH FOR TYPE TESTING

The Successful Bidder shall offer Material for sample selection for Type Testing only after getting Quality Assurance Programme approved by the Owner. The samples for Type Testing shall be manufactured strictly in accordance with the Quality Assurance Programme approved by the Owner.

14.0 EARTHING CONDUCTOR:

GENERAL:

All Conductors buried in earth and concrete shall be of Mild Steel. All Conductors above Ground Level and Earthing Leads shall be of Galvanized Steel, except for Cable Trench Earthing.

CONSTRUCTIONAL FEATURES:

GALVANIZED STEEL:

- a) Steel Conductors above ground level shall be galvanized according to IS: 2629.
- b) The Minimum Weight of the Zinc Coating shall be 618 gm. / sq. m. and minimum thickness shall be 85 microns.
- c) The galvanized surfaces shall consist of a continuous and uniformly thick coating of Zinc, firmly adhering to the surfaces of Steel. The finished surface shall be clean and smooth and shall be free from defects like discoloured patches, bare spots, unevenness of coating, Spelter that is loosely attached to the steel globules, spiky deposits, blistered surfaces, flaking, or peeling off etc. The presence of any of these defects noticed on visual or microscopic inspection shall render the Material liable to rejection.

TESTS:

In accordance with stipulations of the Specifications, Galvanized Steel shall be subjected to four one - minute dips in Copper Sulphate solution as per IS: 2633.

15.0 EARTHING:

Earthing shall be done in accordance with requirements given hereunder. The Successful bidder as per IEEE – 80 and CBIP Manual (**Publication No.: 223 & 331**) shall do the Earthing according to the approval design furnished by the Owner. The Main Earthmat shall be laid in the GIS Substation building area in accordance with the approved design requirements. The Resistivity of the Stone for spreading over the ground shall be 3,000 ohm-m. Neutral Points of Systems of different Voltages, Metallic Enclosures, and Frame Works Associated with all Current Carrying Equipments and extraneous Metal Works associated with Electric System shall be connected to a single Earthing System unless stipulated otherwise.

Earthing and Lightning Protection System installation shall be in strict accordance with the latest editions of Indian Electricity Rules, Relevant Indian Standards and Codes of Practice and Regulations existing in the locality where the System is installed.

- Code of Practice for Earthing IS: 3043
- Code of Practice for the Protection of Building and Allied Structures against Lightning IS: 2309
- Indian Electricity Rules 1956 with latest amendments
- National Electricity Safety Code IEEE – 80 - 2013

DETAILS OF EARTHING SYSTEM

Sr. No.	ITEM	MINIMUM SIZE	MATERIAL
i	Main Earthing Conductor to be buried in Ground	40 mm	Mild Steel Rod
ii	Conductor above Ground and Earthing Leads (for Equipment)	75 x 12 mm G. S. Flat	Galvanized Steel
iii	Conductor above Ground and Earthing Leads (for Columns and Aux. Structures)	75 x 12 mm G. S. Flat	Galvanized Steel
iv	Earthing of Indoor L. T. Panels, Control Panels, 12 kV Switchgear Panels and Outdoor Marshalling Boxes, MOM Boxes, Junction Boxes and Lighting Panels etc	50 x 6 mm G. S. Flat	Galvanized Steel
v	Rod Earth Electrode	40 mm	Mild Steel

		Diameter 3,000 mm Long	
vi	Pipe Earth Electrode (in treated earth pit) as per IS	40 mm Diameter 3,000 mm Long	Galvanized Steel
viii	Earthing Conductor along Outdoor Cable Trenches	50 x 6 mm G. S. Flat	Mild Steel

The sizes of the Earthing Conductor indicated above are the Minimum

EARTHING CONDUCTOR LAYOUT:

Earthing Conductors in Outdoor Areas shall be buried at least 600 mm below finished Ground Level unless stated otherwise. The Outermost Earthing Conductor shall be buried at Twice the normal depth i.e. 1,200 mm in case of 600 mm below the Finished Ground Level.

Wherever Earthing Conductor crosses Cable Trenches, Underground Service Ducts, Pipes, Tunnels, Railway Tracks etc, it shall be laid minimum 300 mm below them and shall be re - routed in case it fouls with Equipment / Structure Foundations.

Tap – Connections from the Earthing Grid to the Equipment / Structure to be earthed shall be terminated on the Earthing Terminals of the Equipment / Structure.

Earthing Conductors or Leads along their run on Cable Trench, Ladder, Columns, Beams, and Walls etc shall be supported by suitable welding / cleating at intervals of 750 mm. Wherever it passes through Walls, Floors etc, galvanized Iron Sleeves shall be provided for the passage of the Conductor and both ends of the Sleeve shall be sealed to prevent the passage of water through the Sleeves.

Earthing Conductor around the Building shall be buried in earth at a minimum distance if 1,500 mm from the Outer Boundary of the Buildings. In case high temperature is encountered at some location, the Earthing Conductor shall be laid minimum 1,500 mm away from such location.

Earthing Conductors crossing the Road shall be laid 300 mm below Road or at greater depth to suit the Site Conditions.

Earthing Conductors embedded in the Concrete shall have approximately 50 mm concrete cover.

EQUIPMENT AND STRUCTURE EARTHING:

Earthing Pads shall be provided for the Apparatus / Equipment at accessible position. The connection between Earthing Pads and the Earthing Grid shall be made by **two short** Earthing Leads (one direct and another through the Support Structure) free from kinks and splices. In case Earthing Pads are not provided on the Item to be earthed, it shall be provided in consultation with Owner.

Steel / R. C. C. Columns, Metallic Stairs etc shall be connected to the nearby Earthing Grid Conductor by two Earthing Leads. Electrical continuity shall be ensured by bonding different Sections of Hand Rails and Metallic Stairs.

Metallic Pipes, Conduits, and Cable Tray Sections for Cable Installation shall be bonded to ensure electrical continuity and connected to Earthing Conductors at regular interval. Apart from intermediate connections, beginning points shall also be connected to Earthing System.

Metallic Conduits shall not be used as earth continuity conductor.

Wherever Earthing Conductor crosses or runs along Metallic Structures such as Gas, Water, Steam Conduits, etc and Steel Reinforcement in Concrete it shall be bonded to the same.

Light Poles, Junction Boxes on the Poles, Cable and Cable Boxes / Glands, Lockout Switches etc shall be connected to the Earthing Conductor running along with the Supply Cable, which in turn shall be connected, to Earthing Grid Conductor at a minimum two points.

Railway Tracks within Switchyard Area shall be earthed at spacing of 30.0 metres and at both ends.

Earthing Conductor shall be buried 1500 mm outside the Switchyard Fence. All the Gates and every alternate Post of the Fence shall be connected to Earthing Grid.

Flexible Earthing Connectors shall be provided for the Moving Parts.

All Lighting Panels, Junction Boxes, Receptacles Fixtures, Conduits etc shall be grounded in compliance with the provision of I. E. Rules.

A Continuous Ground Conductor of 16 SWG GI Wire shall be run all along each conduit run. The Conductor shall be connected to each Panel Ground Bus. All Junction Boxes, Receptacles, Switches, Lighting Fixtures etc shall be connected to this 16 SWG Ground Conductor.

50 mm x 6 mm MS Flat shall run on the top tier and all along the Cable Trenches and the same shall be welded to each of the racks. Further, this Flat shall be earthed at both ends and at an interval of 30 meters. The M. S. Flat shall be finally painted with two coats of Red Oxide Primer and two coats of Post Office Red Enamel Paint.

A 40 mm diameter, 3,000 mm long M. S. Earth Electrode with Test Link, C. I. Frame and Cover shall be provided to connect down conductor of Surge Arrestor, Voltage Transformer, Lightning Masts, and Towers with Peak.

JOINTING:

Earthing connections with Equipments Earthing Pads shall be bolted type. Contact surfaces shall be free from scale, paint, enamel, grease, rust, or dirt. Two Bolts shall be provided for making each connection. Equipment Bolted connections, after being checked and tested, shall be painted **with anti corrosive paint / compound**.

Connection between Equipment Earthing Lead and Main Earthing Conductors and between Main Earthing Conductors shall be welded type. For rust protections, the welds should be treated with Red Lead and afterwards coated with two layers bitumen compound to prevent corrosion.

Steel to Copper connections shall be brazed type and shall be treated to prevent moisture ingress.

Resistance of the Joint shall not be more than the resistance of the equivalent length of the conductor.

All Ground Connections shall be made by electric arc welding. All Welded Joints shall be allowed to cool down gradually to atmospheric temperature before putting any load on it. Artificial cooling shall not be allowed.

Bending of Earthing Rod shall be done preferably by gas heating.

All Arc Welding with large diameter Conductors shall be done with low hydrogen content electrodes.

The 75 x 12 mm G. S. Flat shall be clamped with the Equipment Support Structures at 1,000 mm interval.

SPECIFIC REQUIREMENT FOR EARTHING SYSTEMS

Each Earthing Lead from the neutral of the Power Transformer shall be directly connected to two Pipe Electrodes in **treated earth pit** (as per IS) which in turn, shall be buried in Cement Concrete Pit with a cast iron cover hinged to a cast iron frame to have an access to the Joints. All Accessories associated with Transformer like Cooling Banks, Radiators etc shall be connected to the Earthing Grid at minimum two points.

Earthing Terminal of each Lightning Arrestor shall be directly connected to Rod Earth Electrode, which in turn, shall be connected to Station Earthing Grid.

Auxiliary Earthing Mat comprising of 40 mm diameter M. S. Rods closely spaced (300 mm x 300 mm) Conductors shall be provided at depth of 300 mm from Ground Level below the

Operating Handles of the M. O. M. Box of the Isolators. M. O. M. Boxes shall be directly connected to the Auxiliary Earthing Mat.

INSULATING MATS:

The Scope covers Supply and Laying of Insulating Mats of “Class A” conforming to IS: 15652 -2006.

These Insulating Mats shall be laid in front of all floors mounted AC and DC Switchboards and Control Panels located in Control Room Building.

The Insulating Mats shall be made of Elastomer Material free from any insertions leading to deterioration of insulating properties. It shall be resistant to acid, oil, and low temperature.

Upper surface of the Insulating Mats shall have small aberration (rough surface without edges) to avoid slippery effects while the lower surface shall be plain or could be finished slip resistant without affecting adversely the Dielectric Property of the Mat.

Insulating Mats shall be of pastable type, to be fixed permanently on the front and rear side of the Panels except for the Chequered Plate Area, which shall not be pasted. The Insulating Mats shall generally be fixed and joints shall be welded as per recommendations in Annexure - A of IS: 15652.

Width of Insulating Mats shall generally be of 1.5 metres. Length shall be supplied as per Site Requirements.

The Insulating Mats offered shall conform to all Type, Routine and Acceptance Tests as per IS: 15652 - 2006. Type Test Reports of Insulating Mats shall be submitted for Owner’s acceptance.

16.0 LIGHTNING PROTECTION:

Lightning Masts and Shield Wires shall provide direct Stroke Lightning Protection (DSLPL) in the EHV Switchyard. The installation of the Arrangements shall be as per approved DSLPL drawings, calculations.

The Lightning Protection System shall not be in direct contact with underground metallic service ducts and cab.

Conductors of the Lightning Protection System shall not be connected with the Conductors of the safety Earthing System above ground level.

Down Conductors shall be cleated on the Structures at 2,000 mm interval.

Connection between each Down Conductor and Rod Electrodes shall be made via Test Joint (Pad Type Compression Clamp) located approximately 1,500 mm above ground level. The Rod Electrode shall be further joined with the Main Earthmat.

Lightning Conductors shall not pass through or run inside G. I. Conduits.

17.0 STORAGE:

The Successful Bidder shall provide and construct adequate Storage Shed for proper storage of Equipments, where sensitive Equipments shall be stored indoors. All Equipments during storage shall be protected against damage due to Acts of Nature or Accidents. The Storage Instructions of the Equipment Manufacturer / Owner shall be strictly adhered to.

18.0 CABLING MATERIAL:

CABLE TAGS AND MARKERS:

Each Cable and Conduit run shall be tagged with numbers that appear in the Cable and Conduit Schedule.

The Tag shall be of Aluminium with the number punched on it and securely attached to the Cable Conduit by not less than two turns of 20 SWG G. I. Wire conforming to IS: 280. Cable Tags shall be of rectangular shape for Power Cables and of circular shape for Control Cables.

Location of Cables laid directly underground shall be clearly indicated with Cable Marker made of Galvanized Iron Plate.

Location of Underground Cable Joints shall be indicated with Cable Marker with an additional inscription "Cable Joints".

The Marker shall project 150 mm above ground and shall be spaced at an interval of 30 meters and at every change in direction. They shall be located on both sides of road and drain crossings.

Cable Tags shall be provided on all Cables at each end (just before entering the Equipment enclosure), on both sides of a wall or floor crossing, on each duct / conduit entry and at each end and turning point in Cable Tray / Trench runs. Cable Tags shall be provided inside the Switchgear, Motor Control Centres, Control and Relay Panels etc, wherever required for Cable Identification, where a number of Cables enter together through a Gland Plate.

CABLE SUPPORTS AND CABLE TRAY MOUNTING ARRANGEMENTS

The Successful bidder shall provide embedded Steel Inserts on concrete floors / walls to secure supports by welding to these inserts or available building steel structures.

The Supports shall be fabricated from standard structural steel members.

Insert Plates will be provided at an interval of 750 mm wherever Cables are to be supported without the use of Cable Trays, such as in Trenches, while at all other places these will be at an interval of 2,000 mm.

Vertical Run of Cables on Equipment Support Structure shall be supported on Perforated Cable Trays of suitable width, which shall be suitably bolted / clamped, with the Equipment Support Structure.

CABLE TERMINATION AND CONNECTIONS:

The Termination and Connection of Cables shall be done strictly in accordance with Cable and Termination Kit Manufacturers Instructions, Drawing and / or as directed by the Owner.

The Work shall include all clamping, fittings, fixing, plumbing, soldering, drilling, cutting, tapping, heat shrinking (where applicable), connecting to cable terminal, shorting and grounding as required to complete the job.

Supply of all Consumable Material shall be in the Scope of Successful bidder.

The Equipment will be generally provided with undrilled Gland Plates for cables / conduit entry. The Successful bidder shall be responsible for drilling of Gland Plates, painting, and touching up. Holes shall not be made by gas cutting.

Control Cable Cores entering Control Panel / Switchgear / MCCB / MCC / Miscellaneous Panels shall be neatly bunched, clamped and tied with nylon strap or PVC perforated strap to keeping them in position.

The Successful Bidder shall Tag / Ferrule Control Cable Cores at all terminations, as instructed by the Owner. In Panels where a large number of Cables are to be terminated and Cable Identification may be difficult, each core ferrule may include the complete Cable Number as well.

Spare Cores shall be similarly tagged with Cable Numbers and coiled up.

All Cable Entry Points shall be sealed and made vermin and dust proof. Unused openings shall be effectively closed.

Double Compression Type Nickel Plated (coating thickness not less than 10 microns) Brass Cable Glands shall be provided by the Successful bidder for all Power and Control Cables to provide dust and weather proof terminations.

The Cable Glands shall be tested as per BS: 6121. They shall comprise of heavy - duty brass casting, machine finished, and nickel plated, to avoid corrosion and oxidation. Rubber components used in Cable Glands shall be Neoprene and of tested quality. Cable Glands shall be of approved Make.

The Cable Glands shall also be tested for dust proof and weatherproof termination. The Test Procedure has to be discussed and agreed to between Owner and Cable Gland Manufacturer.

If the Cable - End Box or Terminal Enclosure provided on the Equipment is found unsuitable and requires modification, the Successful bidder, as directed by the Owner shall carry the same out.

Crimping Tool used shall be of approved design and make.

Cable Lugs shall be Tinned Copper Solder Less Crimping Type conforming to IS: 8309 and IS: 8394. Bimetallic Lugs shall be used depending upon type of Cables used.

Solder less Crimping of Terminals shall be done by using corrosion inhibitory compound. The Cable Lugs shall suit the type of terminals provided.

STORAGE AND HANDLING OF CABLE DRUMS:

Cable Drums shall be unloaded, handled and stored in an approved manner and rolling of Drums shall be avoided as far as possible. For short distances, the Drums may be rolled provided they are rolled slowly and in proper direction as marked on the Drum.

19.0 DIRECTLY BURIED CABLES:

The Successful bidder shall construct the Cable Trenches required for directly buried Cables. The Scope of Work shall include excavation, preparation of sand bedding, soil cover, supply, and installation of brick or concrete protective covers, back filling and ramming, supply and installation of Route Markers and Joint Markers. **The Bidder shall ascertain the Soil Conditions prevailing at Site, before submitting the Bid.**

The Cable (Power and Control) between L. T. Station, Control Room, Fire Fighting Pump House, and Switchyard shall be laid in the buried Cable Trenches. In addition to the above, for Lighting Purpose also buried Cable Trench can be used in Outdoor Area.

Cable Route and Joint Markers and RCC Warning Covers shall be provided wherever required. The Voltage Grade of Cables shall be engraved on the Marker.

20.0 INSTALLATION OF CABLES:

Cablings in the Control Room shall be done on Ladder Type Cable Trays while Cablings in Switchyard Area shall be done on angles in the Trench.

All Cables from Bay Cable Trench to Equipments including all Inter Pole Cables (both Power and Control) for all Equipment, shall be laid in PVC Pipes of 50 / 100 / 200 mm as per IS: 4985, which shall be buried in the ground at a depth of 250 mm., below finish formation level.

Separate PVC Pipes shall be laid for Control and Power Cables. The Scope shall include all Labour, Material, and Equipment for transporting, laying, burying etc including required bends and end seals. Cable Pull Boxes of adequate size shall be provided if required.

Cables shall be generally located adjoining the Electrical Equipment through the pipe insert embedded in the floor. In the case of Equipments located away from Cable Trench either Pipe Inserts shall be embedded in the floor connecting the Cable Trench and the Equipment or in case the distance is small, notch/opening on the wall shall be provided. In all these cases, necessary bending radius as recommended by the Cable Manufacturer shall be maintained.

Cable Racks and Supports shall be painted after installation with two coats of Metal Primer (comprising of Red Oxide and Zinc Chromate in a synthetic medium) followed by two finishing coats of Aluminium Paint. The Red Oxide and Zinc Chromate shall conform to IS: 2074. All Welding Works inclusive of the consumables required for fabrication and installation shall be in the scope of the Successful bidder.

Suitable arrangement should be used between Fixed Pipe / Cable Trays and Equipment Terminal Boxes, where vibration is anticipated.

Power and Control Cables in the Cable Trench shall be laid in separate tiers. The order of laying of various Cables shall be as follows, for Cables other than directly buried.

- a) Power Cables on Top Tiers.
- b) Control Instrumentation and other Service Cables in Bottom Tiers.

Single Core Cables in trefoil formation shall be laid with a distance of three times the diameter of Cable between trefoil centre lines. All Power Cables shall be laid with a minimum centre-to-centre distance equal to twice the diameter of the Cable of higher size of Cables.

Trefoil Clamps for Single Core Cables shall be of Pressure Die Cast Aluminium (LM - 6), Nylon - 6 or Fibre Glass and shall include necessary fixing G. I. Nuts, Bolts, Washer etc These are required at every 2,000 mm of Cable runs.

Power and Control Cables shall be securely fixed to the Trays / Supports with self - locking type nylon ties with interlocking facility at every 5,000 mm interval for horizontal run. Vertical and Inclined Cable runs shall be secured with 25 mm wide and 2 mm thick Aluminium Strip Clamps at every 2,000 mm.

Cable shall not be bent below the Minimum Permissible Limit. The Permissible Limits are as follows:

TYPE OF CABLE	MINIMUM BENDING RADIUS
Power Cable	15 D
Control Cable	10 D

D is Overall Diameter of Cable

Where Cables cross roads, drains and rail tracks, these shall be laid in reinforced spun concrete or steel pipes buried at not less than 1,000 mm depth.

In each Cable run some extra length shall be kept at a suitable point to enable (one for L. T. Cables) / two (for H. T. Cables) straight through joints to be made in case the Cable develop fault at a later date.

Selection of Cable Drums for each run shall be so planned as to avoid using straight through Joints. Cable Splices will not be permitted except where called for by the drawings, unavoidable or where permitted by the Owner. If straight through joints is unavoidable, the Successful bidder shall use the Straight through Joints Kit of Reputed Make.

Control Cable Terminations inside Equipment Enclosures shall have sufficient lengths so that changing of termination in Terminal Blocks can be done without requiring any splicing.

Metal Screen and Armour of the Cable shall be bonded to the Earthing System of the Sub Station, wherever required by the Owner.

Rollers shall be used at intervals of about two metres while pulling Cables.

All due care shall be taken during unreeling, laying and termination of Cable to avoid damage due to twist, kinks, sharp bends, etc

Cable Ends shall be kept sealed to prevent damage. In cable vault, fire resistant seal shall be provided underneath the Panels.

Inspection on receipt, unloading and handling of Cables shall generally be in accordance with IS: 1255 and other Indian Standard Codes of Practices.

Wherever Cable pass through floor or through wall openings or other partitions, GI / PVC Wall Sleeves with bushes having a smooth curved internal surface so as not to damage the Cable, shall be supplied, installed and properly sealed by the bidder at no extra charges.

Successful bidder shall remove the RCC / Steel Trench Covers before taking up the Work and shall replace all the Trench Covers after the Erection Work in that particular area is completed or when further Work is not likely to be taken up for some time.

Successful bidder shall furnish three copies of the Report on Work Carried out in a particular week, indicating Cables Numbers, Date on which laid, Actual Length and Route, Testing

Carried Out, Terminations Carried Out, along with the marked up copy of the Cable Schedule and Interconnection Drawing wherever any modifications are made.

Successful bidder shall paint the Tray Identification Number on each run of Trays at an interval on 10.0 metres.

In case the Outer Sheath of a Cable is damaged during handling / installation, the Successful bidder shall repair it at his own cost to the satisfaction of the Owner. In case any other part of a Cable is damaged, a healthy Cable at no extra cost to the Owner shall replace the same; i.e. the Successful bidder shall not be paid for installation and removal of the damage Cable.

All Cable Terminations shall be appropriately tightened to ensure secure and reliable connections. The Successful bidder shall cover the exposed part of all Cable Lugs whether supplied by him or not with insulating tape, sleeve, or paint.

CABLE TRAYS:

- (i) The Cable Trays shall be of G. S. Sheet and minimum thickness of sheet shall be 2 mm.
- (ii) The Successful bidder shall perform all Tests and Inspection to ensure that Material and Workmanship are according to the relevant standards. The Bidder shall have to demonstrate all Tests as per Specification and Equipment shall comply with all requirements of the Specification.
 - a) **Test for Galvanizing** (Acceptance Test) - The Test shall be done as per approved standards.
 - b) **Deflection Test:** (Type Test) - A 2.5 metres straight section of 300 mm, 600 mm wide Cable Tray shall be simply supported at two ends. A Uniform Distributed Load of 76 kg / m shall be applied along the Length of the Tray. The Maximum Deflection at the mid - span shall not exceed 7 mm.

CONDUITS, PIPES, AND DUCT INSTALLATION:

Successful bidder shall supply and install all Rigid Conduits, Mild Steel Pipes, Flexible Conduits, and Hume Pipes etc including all necessary Sundry Materials such as Tees, Elbows, Check Nuts, Bushing, Reducers, Enlargers, Coupling Cap, Nipples, Gland Sealing Fittings, and Pull Boxes etc as specified and to be shown in Detailed Drawing. The size of the conduit / pipe shall be selected on the basis of 40 % fill criterion.

The Bidder shall have his own facility for bending, cutting, and threading the Conduits at Site. Cold Bending should be used. All cuts and threaded ends shall be made smooth

without leaving any sharp edges. Anticorrosive Paint shall be applied at all fields threaded portions.

All Conduit / Pipes shall be extended on both sides of wall / floor openings. The fabrication and installation of supports and the clamping shall be included in the Scope of Work by Successful bidder.

When two lengths of Conduits are joined together through a coupling, running threads equal to twice the length of coupling shall be provided on each Conduit to facilitate easy dismantling of two Conduits.

Conduit installation shall be permanently connected to earth by means of special approved type of Earthing Clamps. G. I. Pull Wire of adequate size shall be laid in all Conduits before installation.

Each Conduit run shall be painted with its designation as indicated on the Drawings such that it can be identified at each end.

Embedded Conduits shall have a minimum concrete cover of 50 mm.

Conduit Run Sleeves shall be provided with the bushings at each end.

Metallic Conduit runs at termination shall have two lock nuts and a bushing for connection. Flexible Conduits shall also be suitably clamped at each end with the help of bushings. Bushings shall have rounded edges so as not to damage the Cables.

Where embedded Conduits turn upwards from a slab or fill, the Termination dimensions shown on the Drawings, if any, shall be taken to represent the position of the straight extension of the Conduit external to and immediately following the bend. At least one - half of the arc length of the bend shall be embedded.

All Conduits / Pipes shall have their ends closed by caps until Cables are pulled. After Cables are pulled, the ends of Conduits / Pipes shall be sealed in an approved manner to prevent damage to threaded portions and entrance of moisture and foreign material.

For Underground Runs, The Bidder shall excavate and back fill as necessary.

The Bidder shall supply, unload, store, and install Conduits required for the Lighting Installation. All Accessories / Fittings required for making the installation complete, including but not limited to pull out boxes, ordinary and inspection tees and elbow, check nuts, male and female bushings (brass or galvanized steel), caps, square headed male plugs, nipples, gland sealing fittings, pull boxes, conduits terminal boxes, gaskets and box covers, saddle terminal boxes, and all steel supporting work shall be supplied by the Bidder. The Conduit Fittings shall be of the same material as Conduits.

All Un-armoured Cables shall run within the Conduits from Lighting Panels to Lighting Fixtures, Receptacles etc.

Exposed Conduits shall be run in straight lines parallel to Building Columns, Beams, and Walls. Unnecessary bends and crossings shall be avoided to present a neat appearance.

Conduit Supports shall be provided at an interval of 750 mm for horizontal runs and 1,000 mm for vertical runs.

Conduit Supports shall be clamped on the approved type Spacer Plates or Brackets by saddles or U – Bolts. The Spacer Plates or Brackets in turn shall be securely fixed to the building steel by welding and to concrete or brickwork by grouting or by nylon rawl plugs. Wooden Plug inserted in the masonry or concrete for Conduit Support is not acceptable.

Embedded Conduits shall be securely fixed in position to preclude any movement. In fixing embedded Conduit, if welding or brazing is used, extreme care should be taken to avoid any injury to the inner surface of the Conduit.

Spacing of embedded Conduits shall be such as to permit flow of concrete between them.

Where Conduits are placed along with Cable Trays, they shall be clamped to supporting steel at an interval of 600 mm.

For directly embedding in soil, the Conduits shall be coated with asphalt - base compound. Concrete Pier or Anchor shall be provided wherever necessary to support the Conduit rigidly and to hold it in place.

Conduits shall be kept, wherever possible, at least 300 mm away from hot pipes, heating devices etc when it is evident that such proximity may reduce the service life of cables.

Slip Joints shall be provided when Conduits cross structural expansion joints or where long run of exposed Conduits is installed, so that temperature change will cause no distortion due to expansion or contraction of Conduit run.

For long Conduit run, Pull Boxes shall be provided at suitable intervals to facilitate wiring. Conduit shall be securely fastened to Junction Boxes or Cabinets, each with a lock nut inside and outside the box.

Conduit Joints and Connections shall be made thoroughly watertight and rust proof by application of a thread compound, which insulates the joints. White Lead is suitable for application on embedded Conduit and Red Lead for exposed Conduit.

Field Bends shall have a minimum radius of four (4) times the Conduit Diameter. All Bends shall be free of kinks, indentations or flattened surfaces. Heat shall not be applied in making any Conduit Bend. Separate Bends may be used for this purpose.

The entire Metallic Conduit System, whether embedded or exposed, shall be electrically continuous and thoroughly grounded. Where Slip Joints are used, suitable bonding shall be provided around the Joint to ensure a continuous ground circuit.

After installation, the Conduits shall be thoroughly cleaned by compressed air before pulling in the wire.

Lighting Fixtures shall not be suspended directly from the Junction Box in the Main Conduit run.

21.0 JUNCTION BOX:

- a) The Bidder shall supply and install Junction Boxes complete with Terminals as required. The brackets, bolts, nuts, screws etc required for Erection are also included in the Scope of the Bidder.
- b) Junction Boxes having volume less than 1,600 cubic centimetres may be installed without any support other than that resulting from connecting Conduits where two or more rigid metallic Conduits enter and accurately position the Box. Boxes shall be installed so that they are level, plumb and properly aligned to present a pleasing appearance.
- c) Boxes with volumes equal to or greater than 1,600 cubic centimetres and smaller Boxes terminating on less than two rigid metallic Conduits or for other reasons not rigidly held shall be adequately supported by auxiliary steel of standard steel shapes or plates to be fabricated and installed. The Bidder shall perform all drilling, cutting, welding, shimming, and bolting required for attachment of supports.

22.0 TESTING AND COMMISSIONING:

An indicative List of Tests for Testing and Commissioning is given below. Bidder shall perform any Additional Test based on specialties of the Items as per the Field Quality Planning / Instructions of the Equipment Contractor or Owner without any extra cost to the Owner. The Bidder shall arrange all Equipments, Instruments, and Auxiliaries required for Testing and Commissioning of Equipments along with calibration certificates and shall furnish the List of Instruments to the Owner for approval.

GENERAL CHECKS:

- (a) Check for Physical Damage
- (b) Visual Examination of Zinc Coating / Plating
- (c) Check from Name Plate that all Items are as per Order / Specification

- (d) Check Tightness of all Bolts, Clamps and Connecting Terminals using Torque Wrenches
- (e) For Oil Filled Equipment, Check for Oil Leakage, if any. Also, check Oil Level and top up wherever necessary
- (f) Check Ground Connections for quality of weld and application of Zinc rich paint over weld joint of galvanized surfaces
- (g) Check cleanliness of Insulator and Bushings
- (h) All checks and tests specified by the Manufacturers in their Drawings and Manuals as well as all Tests specified in the relevant Code of Erection
- (i) Check for Surface Finish of Grading Rings (Corona Control Ring)
- (j) Pressure Test on all pneumatic lines at 18.5 times the Rated Pressure shall be conducted

STATION EARTHING:

- (a) Check Soil Resistivity
- (b) Check Continuity Of Grid Wires
- (c) Check Earth Resistance of The Entire Grid as well as Various Sections of the same
- (d) Check for Weld Joint and Application of Zinc Rich Paint on Galvanized Surfaces.
- (e) Dip Test on Earth Conductor prior to use.

ACSR STRINGING WORK, AND POWER CONNECTORS:

- a) Physical Check for Finish
- b) Electrical Clearance Check
- c) Testing of Torque by Torque - Wrenches on all Bus Bar Power Connectors and Other Accessories
- d) milli - Volt Drop Test on all Power Connectors
- e) Sag and Tension Check on Conductors

INSULATOR:

Visual Examination for Finish, Damage, Creepage Distance etc

All Pre - Commissioning Activities and Works, Work for Substation Equipment shall be carried out in accordance with Owner's directions, by the Successful Bidder.

TESTING PROCEDURE FOR ACSR CONDUCTOR

1.0 UTS TEST ON STRANDED CONDUCTOR

Circles perpendicular to the axis of the Conductor shall be marked at two places on a sample of Conductor of minimum 5.0 metres length suitably compressed with Dead End Clamps at either end. The Load shall be increased at a steady rate upto 80 kN and held for one minute. The circles drawn shall not be distorted due to relative movement of Strands. Thereafter the Load shall be increased at a steady rate to 161.2 kN and held for one minute. The applied Load shall then be increased until the Failing Load is reached and the value recorded.

2.0 CORONA EXTINCTION VOLTAGE TEST

Two samples of Conductor of 5.0 metres length shall be strung with a spacing of 450 mm between them at a height not exceeding 8.0 metres above ground. This Assembly shall be tested as per Annexure - C, Corona Extinction Voltage shall not be less than 154 kVrms Line to Ground for 220 kV.

3.0 RADIO INTERFERENCE VOLTAGE TEST

The sample assembly similar to that specified under (2.0) above shall be tested as per Annexure - C. Maximum RIV Level (across 300 ohm resistor at 1 MHz) at 156 kVrms Line to Ground Voltage for 220 kV Voltage respectively, shall be 1,000 micro Volts.

4.0 DC RESISTANCE TEST ON STRANDED CONDUCTOR

On a Conductor sample of minimum 5.0 metres length two Contact Clamps shall be fixed with a pre - determined Bolt Torque. The Resistance shall be measured by a Kelvin Double Bridge by placing the Clamps initially zero metre and subsequently one metre apart. The test shall be repeated at least five times and the average value recorded. The value obtained shall be corrected to the value at 20° as per Clause No. 12.8 of IS: 398 (Part - V) - 1982. The resistance corrected at 20° shall conform to the requirements of this Specification.

5.0 CHEMICAL ANALYSIS OF ZINC

Samples taken from the Zinc Ingots shall be chemically / spectrographically analysed. The same shall be in conformity to the requirements stated in this Specification.

6.0 CHEMICAL ANALYSIS OF ALUMINIUM AND STEEL

Samples taken from the Aluminium Ingots / Coils / Strands shall be chemically / spectrographically analysed. The same shall be in conformity to the requirements stated in this Specification.

7.0 VISUAL CHECK FOR JOINTS, SCRATCHES etc

Conductor Drums shall be rewound in the presence of the Inspector. The Inspector shall visually check for scratches, joints, etc and that the Conductor generally conforms to the requirements of this Specification. The Length of Conductor wound on the Drum shall be measured with the help of Counter Meter during rewinding.

8.0 DIMENSIONAL CHECK FOR STEEL AND ALUMINIUM STRANDS

The Individual Strands shall be dimensionally checked to ensure that they conform to the requirements of this Specification.

9.0 CHECK FOR LAY RATIOS OF VARIOUS LAYERS

The Lay Ratios of various Layers shall be checked to ensure that they conform to the requirements of this Specification and Clause No. 9.4 and 9.5 of IS: 398 (Part - V) 1982.

10.0 GALVANISING TEST

The Test Procedure shall be as specified in IS: 4826 -1 968. The material shall conform to the requirements of this Specification.

11.0 TORSION AND ELONGATION TESTS ON STEEL STRANDS

The Test Procedures shall be as per relevant clause of IS: 398 (Part - V), 1982. In Torsion Test, the number of complete twists before fracture shall not be less than 18 on a length equal to 100 times the standard diameter of the strand before stranding and 16 after stranding. In case test sample length of less or more than 100 times the standard diameter of the strand, the minimum number of twist will be proportionate to the length and if number comes in the fraction then it will be rounded off to next higher whole number. In Elongation Test, the elongation of the strand shall not be less than 4 % for a gauge length of 200 mm.

12.0 BREAKING LOAD TEST ON WELDED ALUMINIUM STRAND

Two Aluminium Wires shall be welded as per the approved Quality Plan and shall be subjected to Tensile Load. The Welded Point of the Wire shall be able to withstand the minimum Breaking Load of the individual strand guaranteed by the Bidder.

ANNEXURE – B

TESTING PROCEDURE FOR GALVANISED STEEL EARTHWIRE

1.0 UTS TEST

Circles perpendicular to the axis of the Earthwire shall be marked at two places on a sample of Earthwire of minimum 5.0 metres length suitably compressed with Dead End Clamps at either end. The Load shall be increased at steady rate upto 34 kN and held for one minute. The circles drawn shall not be distorted due to relative movement of strands. Thereafter, the Load shall be increased at a steady rate of 68.4 kN and held for one minute. The Earthwire sample shall not fail during this period. The Applied Load shall then be increased until the Failing Load is reached and value recorded.

2.0 D.C. RESISTANCE TEST

On an Earthwire sample of minimum 5.0 metres length, two Contact Clamps shall be fixed with a predetermined Bolt Torque. The Resistance shall be measured by a Kelvin Double Bridge by placing the Clamps initially zero metre and subsequently one metre apart. The test shall be repeated at least five times and the average value recorded. The value obtained shall be corrected to the value at 20 shall conform to the requirements of this Specification.

3.0 VISUAL CHECK FOR JOINTS, SCRATCHES etc AND LENGTH OF EARTHWIRE

Earthwire Drums shall be rewound in the presence of the Inspector. The Inspector shall visually check for joints, scratches etc and see that the Earthwire generally conforms to the requirements of this Specification. The length of Earthwire wound on the Drum shall be measured with the help of Counter Meter during rewinding.

4.0 TORSION AND ELONGATION TESTS

The Test Procedure shall be as per relevant clause of IS: 398 (Part - V). The minimum number of twists, which a Single Steel Strand shall withstand during Torsion Test, shall be eighteen for a length equal to 100 times the standard diameter of the strand. In case the test sample length is less or more than 100 times the standard diameter of the strand, the minimum number of twists will be proportionate to the length and if number comes in the fraction then it will be rounded off to next higher whole number. In Elongation Test, the elongation of the strand shall not be less than 64 % or a gauge length of 200 mm.

5.0 DIMENSIONAL CHECK

The Individual Strands shall be dimensionally checked to ensure that they conform to the requirements of this Specification.

6.0 LAY LENGTH CHECK

The Lay Length shall be checked to ensure that they conform to the requirements of this Specification.

7.0 GALVANISING TEST

The Test Procedure shall as specified in IS: 4826 - 1968. The material shall conform to the requirements of this Specification.

8.0 CHEMICAL ANALYSIS OF ZINC USED FOR GALVANIZING

Samples taken from Zinc Ingots shall be chemically / spectrographically analysed. The same shall be in conformity to the requirements stated in this Specification.

9.0 CHEMICAL ANALYSIS OF STEEL

Samples taken from Steel Ingots / Coils / Strands shall be chemically / spectrographically analysed. The same shall be in conformity to the requirements stated in this Specification

ANNEXURE – C

CORONA AND RADIO INTERFERENCE VOLTAGE (RIV) TEST

1.0 GENERAL

Unless otherwise stipulated, all Equipment together with its Associated Connectors, where applicable, shall be tested for External Corona by observing the Voltage Level for the Extinction of Visible Corona under falling Power Frequency Voltage and by measurement of Radio Interference Voltage (RIV).

2.0 TEST LEVELS

The Test Voltage Levels for measurement of external RIV and for Corona Extinction Voltage are listed under the relevant Clauses of the Specification.

3.0 TEST METHODS FOR RIV

- 3.1. RIV Tests shall be made according to measuring circuit as per International Special - Committee on Radio Interference (CISPR) Publication 16 – 1 (1993) Part - 1. The measuring circuit shall preferably be tuned to frequency with 10 % of 0.5 MHz but other frequencies in the range of 0.5 MHz to 2 MHz may be used, the measuring frequency being recorded. The results shall be in micro Volt.
- 3.2. Alternatively, RIV Tests shall be in accordance with NEMA Standard Publication No. 107 - 1964, except otherwise noted herein.
- 3.3. In measurement of RIV, temporary additional external Corona Shielding may be provided. In measurements of RIV only standard Fittings of identical type supplied with the Equipment and a simulation of the connections as used in the actual installation will be permitted in the vicinity within 3.5 metres of terminals.
- 3.4. Ambient Noise shall be measured before and after each series of tests to ensure that there is no variation in ambient noise level. If variation is present, the lowest ambient noise level will form basis for the measurements. RIV Levels shall be measured at increasing and decreasing Voltages of 85 %, 100 %, and 110 % of the specified RIV Test Voltage for all Equipment unless otherwise specified. The specified RIV Test Voltage for 220 kV is listed in the detailed Specification together with maximum permissible RIV Level in micro Volt.
- 3.5. The Metering Instruments shall be as per CISPR recommendation or equivalent device so long as it has been used by other Testing Authorities.
- 3.6. The RIV measurement may be made with a Noise Meter. A Calibration Procedure of the Frequency to which Noise Meter shall be tuned shall establish the ratio of Voltage at the High Voltage Terminal to Voltage read by Noise Meter.

4.0 TEST METHODS FOR VISIBLE CORONA

The purpose of this Test is to determine the Corona Extinction Voltage of Apparatus, Connectors etc. The Test shall be carried out in the same manner as RIV Test described above with the exception that RIV measurements are not required during test and a search technique shall be used near the onset and Extinction Voltage when the Test Voltage is raised and lowered to determine their precise values. The Test Voltage shall be raised to 110 % of RIV Test Voltage and maintained there for five minutes. In case Corona inception does not take place at 110 %, test shall be stopped, otherwise test shall be continued, and the Voltage will then be decreased slowly until all Visible Corona disappears. The procedure shall be repeated at least 4 times with Corona inception and Extinction Voltage recorded each time. The Corona Extinction Voltage for purposes of determining compliance with the Specification shall be the lowest of the four values at which visible Corona (negative or positive polarity) disappears. Photographs with Laboratory in complete darkness shall be taken under Test Conditions, at all Voltage steps i.e. 85 %, 100 %, and 110 %. Additional photographs shall be taken at Corona Inception and Extinction Voltages. At least two views shall be photographed in each case using panchromatic film with an ASA daylight rating of 400 with an exposure of two minutes at a lens aperture of f/5.6 or equivalent. The photographic process shall be such that prints are available for inspection and comparison with conditions as determined from direct observation. Photographs shall be taken from above and below the level of connector to show Corona on Bushing, Insulators and all parts of energised connectors. The photographs shall be framed such that Test Object essentially, fills the frame with no cut-off.

In case Corona Inception does not take place at 110 %, Voltage shall not be increased further and Corona Extinction Voltage shall be considered adequate.

- 4.1** The Test shall be recorded on each photograph. Additional photograph shall be taken from each camera position with lights on to show the relative position of Test Object to facilitate precise Corona location from the photographic evidence.
- 4.2** In addition to photographs of the Test Object, preferably four photographs shall be taken of the complete Test Assembly showing relative positions of all the Test Equipment and Test Objects. These four photographs shall be taken from four points equally spaced around the test arrangement to show its features from all sides. Drawings of the Laboratory and Test Set up locations shall be provided to indicate camera positions and angles. The precise location of camera shall be approved by Purchaser's Inspector, after determining the best camera locations by trial energisation of Test Object at a Voltage, which results in Corona.
- 4.3** The Test to determine the Visible Corona Extinction Voltage need not be carried out

simultaneously with test to determine RIV Levels.

- 4.4** However, both Tests shall be carried out with the same Test Set Up and as little time duration between Tests as possible. No modification on treatment of the sample between Tests will be allowed. Simultaneous RIV and Visible Corona Extinction Voltage Testing may be permitted at the discretion of Purchaser's Inspector if, in his opinion, it will not prejudice other Test.

5.0 TEST RECORDS

In addition to the information previously mentioned and the requirements specified as per CISPR or NEMA 107 – 1964, the following Data shall be included in Test Report:

- a) Background Noise before and after Test
- b) Detailed Procedure of application of Test Voltage
- c) Measurements of RIV Levels expressed in micro Volt at each level
- d) Results and observations with regard to location and type of interference sources detected at each step
- e) Test Voltage shall be recorded when measured RIV passes through 100 microvolt in each direction
- f) Onset and Extinction of Visual Corona for each of the four Tests required shall be recorded

ANNEXURE – D

**STANDARD TECHNICAL DATA SHEETS FOR AAC / ACSR CONDUCTORS, GS
EARTHWIRE**

GENERAL

Owner has standardised the Guaranteed Technical Particulars for the following AAC / ACSR Conductors, Galvanised Steel Earthwire. The Bidder shall supply the Conductors as per the standard GTP mentioned below. Any deviation to the following GTP shall be clearly brought out by the Bidder in their Bid.

1.1 GUARANTEED TECHNICAL PARTICULARS (GTP) FOR CONDUCTORS

A. GTP OF ACSR ‘MOOSE’ CONDUCTOR:

Sr. No.	DESCRIPTION	UNIT	ACSR MOOSE
1.0	Applicable Standard		IS:398 / IEC: 1089
2.0	Raw Materials		
2.1	Aluminium		
a)	Minimum Purity of Aluminium	%	99.50
b)	Maximum Copper Content	%	0.04
2.2	Steel Wires / Rods		
a)	Carbon	%	0.50 to 0.85
b)	Manganese	%	0.50 to 1.10
c)	Phosphorous	%	Not more than 0.035
d)	Sulphur	%	Not more than 0.045
e)	Silicon	%	0.10 to 0.35 (Max.)
2.3	Zinc		
a)	Minimum Purity of Zinc	%	99.95

Sr. No.	DESCRIPTION	UNIT	ACSR MOOSE
3.0	Aluminium Strands after Stranding		
3.1	Diameter		
a)	Nominal	mm	3.53
b)	Maximum	mm	3.55
c)	Minimum	mm	3.51
3.2	Minimum Breaking Load of Strand		
a)	Before Stranding	kN	1.57
b)	After Stranding	kN	1.49
3.3	Maximum DC Resistance of strand at 20 degrees Centigrade	ohm / km	2.921
4.0	Steel Strand after Stranding		
4.1	Diameter		
a)	Nominal	mm	3.53
b)	Maximum	mm	3.60
c)	Minimum	mm	3.46
4.2	Minimum Breaking Load of Strand		
a)	Before Stranding	kN	12.86
b)	After Stranding	kN	12.22
4.3	Galvanising		
a)	Minimum Weight of Zinc coating per sq. m.	gm	260
b)	Minimum Number of dips that the Galvanised Strand can withstand in the Standard Preece Test	Nos.	2 dips of one minute and 1 dip of half minute

Sr. No.	DESCRIPTION	UNIT	ACSR MOOSE	
c)	Minimum Number of twists in gauge length equal 100 times the diameter of Wire which the strand can withstand in the Torsion Test (after Stranding)	Nos.	16 (After Stranding) 18 (Before Stranding)	
5.0	ACSR Conductor			
5.1.a)	Stranding		Al – 54 / 3.53 mm + Steel – 7 / 3.53 mm	
b)	Number of Strands			
i.	Steel Centre	Nos.	1	
ii.	1 st Steel Layer	Nos.	6	
iii.	1 st Aluminium Layer	Nos.	12	
iv.	2 nd Aluminium Layer	Nos.	18	
v.	3 rd Aluminium Layer	Nos.	24	
5.2	Sectional Area of Aluminium	sq. mm	528.50	
5.3	Total Sectional Area	sq. mm	597.00	
5.4	Approximate Weight	kg / m	2.004	
5.5	Diameter of the Conductor	mm	31.77	
5.6	UTS of the Conductor	kN	161.20 (Min.)	
5.7	Lay Ratio of the Conductor	mm	Maximum	Minimum
a)	Outer Steel layer	mm	18	16
b)	8 / 12 Wire Aluminium Layer	mm	14	12

Sr. No.	DESCRIPTION	UNIT	ACSR MOOSE	
c)	14 / 18 Wire Aluminium Layer	mm	13	11
d)	20 / 24 Wire Aluminium Layer	mm	12	10
5.8	DC Resistance of the Conductor at 20 °C	ohm / km	0.05552	
5.9	Standard Length of the Conductor	m	1,800	
5.10	Tolerance on Standard Length	%	(±) 5	
5.11	Direction of Lay of Outer Layer	-	Right Hand	
5.12	Linear Mass of the Conductor			
a)	Standard	kg / km	2,004	
b)	Minimum	kg / km	1,965	
c)	Maximum	kg / km	2,045	
5.13	Modulus of Elasticity (Final State)	kg / sq. mm	6,860	
5.14	Coefficient of Linear Expansion	per deg. C	19.3×10^{-6}	
5.15	Minimum Corona Extinction Voltage	kV _{rms}	320	
5.16	RIV at 1 MHz under Dry Condition	micro Volt	Max. 1,000 at 156 kV _{rms}	
6.0	Drum Dimensions		Generally conforms to IS: 1778	
a)	Flange Diameter	mm	1,800	
b)	Traverse Width	mm	950	

Sr. No.	DESCRIPTION	UNIT	ACSR MOOSE
c)	Barrel Diameter	mm	650
d)	Flange Thickness	mm	50 x 50

1.2 GUARANTEED TECHNICAL PARTICULARS OF GALVANISED STEEL EARTHWIRE

Sr. No.	DESCRIPTION	UNIT	STANDARD VALUES
1.0	Raw Materials		
1.1	Steel Wires / Rods		
a)	Carbon	%	Not more than 0.55
b)	Manganese	%	0.40 to 0.90
c)	Phosphorous	%	Not more than 0.04
d)	Sulphur	%	Not more than 0.04
e)	Silicon	%	0.15 to 0.35
1.2	Zinc		
a)	Minimum Purity of Zinc	%	99.95
2.0	Steel Strands		
2.1	Diameter		
a)	Nominal	mm	3.66
b)	Maximum	mm	3.74
c)	Minimum	mm	3.58
2.2	Minimum breaking load of strand		
a)	After Stranding	kN	10.58
2.3	Galvanising		
a)	Minimum Weight of Zinc coating per sq. m. after Stranding	gm	275

Sr. No.	DESCRIPTION	UNIT	STANDARD VALUES
b)	Minimum Number of dips that the Galvanized Strand can withstand in the Standard Preece Test	Nos.	3 dips of 1 minute and one dip of ½ minute
c)	Minimum Number of twists in a Gauge Length equal to 100 times diameter of Wire which the Strand can withstand in the Torsion Test, after Stranding	Nos.	18
3.0	Stranded Earth Wire		
3.1	UTS of Earth wire	kN	68.4 (min.)
3.2	Lay Length of Outer Steel Layer		
a)	Standard	mm	181
b)	Maximum	mm	198
c)	Minimum	mm	165
3.3	Maximum DC Resistance of Earth Wire at 20 °C	ohm / km	3.375
3.4	Standard Length of EARTH WIRE	m	2,000 or actual quantity whichever is less.
3.5	Tolerance on Standard Length	%	± 5
3.6	Direction of Lay for Outside Layer		Right Hand
3.7	Linear Mass		
a)	Standard	kg / km	583
b)	Maximum	kg / km	552

Sr. No.	DESCRIPTION	UNIT	STANDARD VALUES
c)	Minimum	kg / km	600
3.8	Overall Diameter	mm	10.98

PART-31

HARDWARES

SECTION - I TECHNICAL SPECIFICATION OF CONDUCTORS

1. SCOPE :

This specification provides for the manufacture, testing, supply and delivery at destination of the steel cored aluminum conductors as per Appendix-I attached.

2. STANDARDS :

The conductors shall comply in all respects to the clauses of this specification as indicated below & with the Indian Standard Specification, International standards with latest amendments.

Some of the standards are:-

- i) IS 398 - Specification for Aluminum Conductors for overhead transmission purposes, IS 398, Part-II-Aluminum conductors for overhead Transmission purpose Specification
- ii) IS 1521, 1972 - Method of tensile testing of steel
- iii) IS 1778 -1989 – Reel & drums for bare conductors
- iv) IEC – 1098

3. MATERIALS :-

The material offered shall be of best quality and workmanship. The steel Cored Aluminum conductor strands will consist of hard-drawn aluminum wire manufactured from 99.5% pure electrolytic aluminum rods of E.C. Grade. The steel wire shall be made from materials produced either by the acid or basic open hearth process or by electric process. No steel wire drawn from pressmen process shall be used. The steel wire shall not contain sulphur or phosphorus exceeding 0.05 percent, and the total of sulphur and phosphorus shall not exceed 0.085 percent.

The steel wires shall be evenly and uniformly coated with zinc complying with Indian Standard 4826-1979 specification for galvanized coatings on round steel wires. The uniformity of zinc coating and the weight of coating shall be in accordance with Appendix-II. The coating on the galvanized steel wires may be applied by the hot process or the electrolytic process.

4. SIZES :-

The size of steel-cored Aluminium Conductors shall be as given in Appendix-I. The resistance and weights shall be in accordance with the values given in the same appendix.

5. TOLERANCES :-

The following tolerances shall be permitted on standard diameter of aluminium wires
Tolerance on standard diameter of aluminum wire +/- 1 percent wires.

Note: The cross-section of any wire shall not depart from circularity by more than an Amount corresponding to a tolerance of 2 percent on the standard diameter.

A tolerance of + 2 percent shall be permitted on the standard diameter of the galvanized steel wires. The variation from the approximate weights shall not be more than plus or minus 5 percent.

6. MECHANICAL PROPERTIES :-

The value of the final modules of elasticity for steel cored aluminium conductor in the average of values obtained from actual stress strain tests. The co-efficient of linear expansion for steel Cored Aluminium Conductors has been calculated on the basis of co-efficient of linear expansion of 23.0×10^{-6} per degree centigrade of aluminium and 11.5×10^{-6} per degree centigrade for steel and represent only the average values. These values shall however, be given by the bidder under the guaranteed technical particulars.

7. SURFACE CONDITIONS :-

The wires shall be smooth and free from inequalities, spills and splits. The surface conductor shall be free from points, sharp-edges, abrasions or other departures from smoothness or uniformity of surface contour that would increase radio interference and corona losses. When subjected to tension up to 50% of the ultimate strength of the conductor, the surface shall not depart from its cylindrical form nor any part of the component, parts or strands, move relative to each other in such a way as to get out of place and disturb the longitudinal smoothness of the conductor.

8. JOINTS IN WIRES :-

Aluminium wires: No joints shall be permitted in the aluminium wires in the outermost layer of the ACSR conductor. Joints in the inner layers are permitted, in addition to those made in the base rod or wire before final drawing, but no two such joints shall be less than 15 meter. Apart in the complete stranded conductor. Such joints shall be made by cold pressure butt-welding Joints are not permitted in the outermost layer of the conductor in order to ensure a smooth conductor finish and reduce radio interference levels and corona losses on the extra high voltage lines.

Galvanized steel wires: There shall be no joints except those in the base rod or wire before final drawing, in steel wires forming the core of the steel-reinforced aluminium conductor. Joints have not been permitted in the steel wires after final drawing in order to avoid reduction in the breaking strength of the conductor that may occur as a result of failure of the joints.

9. STRANDING :

The wires used in construction of a stranded conductor shall before stranding, satisfy all requirements of IS-398/ (part-II) 1976 with latest amendments. For steel-cored aluminium conductors the lay ratio of the different layers shall be within the limits given under Appendix-I.

For all, constructions, each alternate layer shall be stranded in opposite directions. The wires in each layer shall be evenly and closely stranded round the under laying wire or wires. The final layer of wires shall have a right hand lay.

10. PACKING AND MARKING :

The conductor shall be wound in non-returnable reels or drums conforming to Indian Standard 1978-1961 specification for Reels and Drums for Bare Wire, or any other authoritative standard and marked with the following : -

- | | |
|--|--|
| a) Trade name, if any | b) Contract/Award letter Number |
| c) Name of manufacturer | d) Name & Address of Consignee |
| e) Drum Number | f) Length of conductor |
| g) Size of conductor | h) Gross Weight of drum with conductor |
| i) Weight of empty drum
with lagging. | j) Net and gross of conductor. |
| k) Arrow marking of un-winding | |

The reel shall be of such construction as to assure delivery of conductor in the field from displacement and damage and should be able to withstand all stresses due to handling and the stringing operations so that conductor surface is not dented, scratched or damaged in any way during manufacture, transport and erection. The conductor shall be properly lagged on the drums and the method of lagging to be employed may be clearly stated in the tender. It should be stocked to suit the reel and held in place by steel strapping. Lagging shall not be nailed or bolted in place.

The conductor drum should be suitable for wheel mounting. Before reeling, the cardboard or other suitable material shall be secured to the drum and inside flanges of the drums. After reeling the conductor, the exposed surfaces should be wrapped with suitable soft material to prevent the conductor from dirt and grit. Any space between the drum lagging and conductor should be suitably filled with soft filler material compactly packed. The conductor drum shall be made as per the relevant IS.

11. LENGTHS : -

The conductor shall be supplied in the standard lengths as below with a permitted variation of 5%. Not less than 90% of the total quantity of the conductor shall be supplied in the standard lengths. Thus the quantity of the conductor in lengths shorter than standard ones shall not exceed 10% of the total quantity to be supplied. Further no single conductor lengths in respect of such 10% (Maximum supply) in random lengths, shall be shorter than 50% of the standard lengths.

Type of conductor	Length per drum
--------------------------	------------------------

12. TESTS AND TEST CERTIFICATES :-

The following type tests, shall be conducted on the conductor at any Govt. approved laboratory or CPRI, in presence of the representatives of OPTCL, on the samples collected and sealed by the representative of OPTCL from manufactured & offered drums of conductor at random at free of cost to OPTCL or firm may quote their test charges which will be taken in to account during bid price evaluation. If test charges will not be quoted by the firm, it will be treated as nil during bid price evaluation & firm have to do the type tests at free of cost to OPTCL. **Also the tenderer shall furnish valid type test reports, the tests are as per the IS 398 (part-2) conducted in any govt. approved laboratory or CPRI.**

Individual wire and finished steel cored Aluminum Conductor shall be subjected to before dispatch from the works, to the tests as per the provision of the Indian standard Specification 398 (Part-II-1976) with the latest amendments & as per the tests indicated in this specification below.

Samples for individual wires for test shall be taken before stranding form not less than 10 percent of the spials in the case of aluminum wire and ten percent of the wire coils in the case of steel wires. If samples are taken after stranding, they shall be obtained by cutting 5 meters from the outer end of the finished conductor from not more than 10 percent of the finished reels.

The mechanical tests shall be carried out on single wires only.

The Tensile test shall apply to wires of all diameters forming part of steel cored aluminium conductors. If it is not possible to test the component wires before stranding the test may be made on wires taken from stranded conductors. The tensile strength of any of the wires shall not be less than the minimum values given in Appendix-II.

A suitable tensile testing machine shall be used the accuracy of which can easily be checked and the machine adjusted if necessary. The test sample before being placed in the machine, shall be straightened, if necessary in such a way as to cause the minimum alteration in its physical properties

The load shall be applied gradually and rate of separation of the Jaws of the testing machine shall not be greater than 10cm/min. and less than 2.5cm/min.

TYPE TESTS**Wrapping Test:**

Samples of aluminium wires shall be wrapped round a wire of its own diameter to form a close helix of eight turns. Six turns shall then be unwrapped and again clearly wrapped in the same direction as before. The wire shall not break.

Samples of steel wires shall be closely wrapped eight times round a mandrel of diameter equal to four times the wire diameter. Six turns shall then be unwrapped and again closely wrapped in the same direction as before. The wire shall not break.

Galvanizing Test:

The uniformity of zinc coating and the weight of coating shall be as given in Appendix-II and shall be determined according to Indian Standard Specification 4826-1979. with latest amendments.

This test shall be made whenever practicable, on wires before stranding and before the specimen has been bent, straightened or tested in any other way.

Ductility Test:

This test shall be made on galvanized steel wires only

Torsion Test:

One specimen cut from each of the sample shall be gripped at its ends in two vices, one of which shall be free to move longitudinally during the test. A small tensile bond not exceeding 2% of the breaking load of the wire, shall be applied to the sample during testing. The specimen shall be twisted by consisting one of the vices to revolve until fracture occurs and the number of twists shall be indicated by a counter or other suitable device. The rate of twisting shall not exceed 60 rev/min.

When tested before stranding, the number of complete twists before fracture occurs shall not be less than 18 on a length equal to 100 times the diameter of the wire. The fracture shall show a smooth surface at right angles, to the axis of the wire.

When tested after stranding, the number of complete twists before fracture occurs shall be not less than 16 on a length equal to 100 times the diameter of the wire. The fracture shall show a smooth surface at right angles to the axis of the wire.

Elongation Test:

The elongation of one specimen cut from each of the samples shall be determined. The specimen shall be straightened by hand and on original gauge length of 200 mm shall be marked on the wire. A tensile load shall be applied as described in 12.5 and the elongation shall be measured after the fractured ends fitted together. If the fracture occurs outside the gauge marks, or within 25mm of either mark and the required elongation is not obtained, the test shall be disregarded and another test made. When tested before stranding, the elongation shall be not less than 4 percent. When tested after stranding, the elongation shall be not less than 3.5 percent.

Surface Condition Test:

A sample of the finished conductor having a minimum recommended length of 5 meters with compression type dead end clamps compressed on both ends in such a manner as to permit the conductor to take its normal straight line shape, shall be subject to a tension of 50% of the UTS of the conductor. The surface shall not depart from its cylindrical shape nor shall the strands move relative to each other so as to get out of place or disturb the longitudinal smoothness of conductor. The measured diameter at any place shall be not less than the sum of the minimum specified diameters of the individual aluminum and steel strands.

Ultimate Strength (UTS) Test on Stranded Conductor:

Circles perpendicular to the axis of the conductor shall be marked at two places on a sample of conductor of minimum 5 m length suitably compressed with dead end clamps at either end. The load shall be increased at a steady rate up to specified 50% of UTS and held for one minute. The circles drawn shall not be distorted due to Relative movement

of strands. Thereafter the load shall be increased at a steady rate to the minimum UTS specified in Appendix-I and for one minute. The applied load shall then be increased until the failing load is reached and the value recorded.

Corona Extinction Voltage Test

One sample of conductor of 5m length shall be strung. This sample assembly when subjected to power frequency voltage shall have a corona extinction voltage of not less than 176 KV (rms) for 220 KV system line to ground under dry condition. There shall be no evidence of corona on any part of sample when all possible sources of corona are photographed in a darkened room. The test shall be conducted without corona control rings. The voltage shall be corrected for standard atmospheric conditions.

Radio Interference Voltage Test

Under the conditions as specified above, the conductor samples shall have a radio interference voltage level below 1500 microvolts at one MHZ when subjected to 50HZ AC voltage of 1.1 times maximum line to ground voltage under dry condition. This test may be carried out with corona control rings and arcing horns.

D.C. Resistance Test on Stranded Conductor

On a conductor sample of minimum 5 m length two contact clamps shall be fixed with a predetermined bolt torque. The resistance shall be measured by a Kelvin double bridge by placing the clamps initially zero meter and subsequently one meter apart. The test shall be repeated at least five times and the average value recorded. The value obtained shall be corrected to the value at 20 degree centigrade as per clause No.12.8 of IS: 398 (part V). The resistance corrected at 20 degree centigrade shall conform to the requirements of this specification.

Stress-Strain Test

This test is contemplated only to collect the creep data of the conductor from the supplier. A sample of conductor of minimum 10 metres length shall be suitably compressed with dead end clamps.

Test Set-up

The test sample shall be supported in a trough over its full length and the trough adjusted so that the conductor will not be lifted by more than 10 mm under tension. This shall be ascertained by actual measurement.

The distance between the clamp and the sleeve mouth shall be monitored with callipers during the test to ensure that, after the test, it does not change by more than 1 mm +/- 0.1mm from the value before the test.

The conductor strain shall be evaluated from the measured displacements at the two ends of the gauge length of the sample. The gauge reference targets shall be attached to the clamps which lock the steel and aluminum wires together. Target plates may be used with dial gauges or displacement transducers and care shall be taken to position the plates perpendicular to the conductor. Twisting the conductor, lifting it and moving it from side-to-side by the maximum amounts expected during the test should introduce no more than 0.3mm error in the reading.

Test Loads for Complete Conductor:

The loading conditions for repeated stress-strain tests for complete conductor shall be as follows:

1 KN load shall be applied initially to straighten the conductor. The load shall be removed after straightening and then the strain gauges are to be set at zero at zero tension.

For non-continuous stress-strain data, the strain reading at 1 KN intervals at lower tensions and 5KN intervals above 30% of UTS shall be recorded.

The sample shall be reloaded to 50% of UTS and held for 1 hour. Readings are to be noted after 5, 10, 15, 30, 45 and 60 minutes during the hold period. The load shall be released after the hold period.

Reloading up to 70% of UTS shall be done and held for 1 hour. Readings are to be noted after 5, 10, 15, 30, 45, and 60 minutes and then the load shall be released.

Reloading up to 85% of UTS shall be done and hold for 1 hour. Readings are to be noted after 5, 10, 15, 30, 45 and 60 minutes and then the load shall be released.

Tension shall be applied again and shall be increased uniformly until the actual breaking strength is reached. Simultaneous readings of tension and elongation shall be recorded up to 90 % of UTS at the intervals.

Test Loads for Steel core only:

The loading conditions for repeated stress-strain tests for the steel core of ACSR shall be as follows:

The test shall consist of successive application of load applied in a manner similar to that for the complete conductor at 30%, 50%, 70% and 85% of UTS.

The steel core shall be loaded until the elongation at the beginning of each hold period corresponds to that obtained on the complete conductor at 30%, 50%, 70% and 85% of UTS respectively.

Stress Strain Curves

The design stress-strain curve shall be obtained by drawing a smooth curve through the 0.5 and 1 hour points at 30%, 50%, and 70% of UTS loadings. The presence of any aluminum slack that can be related to any observed extrusion entering the span from the compression dead ends shall be removed from the lower ends of the design curves. Both the laboratory and design stress-strain curves shall be submitted to the Owner along with test results. The stress-strain data obtained during the test shall be corrected to the standard temperature i.e. 20 degree centigrade.

Chemical Analysis of Zinc

Samples taken from the Zinc ingots shall be chemically/ spectrographically analysed. The same shall be in conformity to the requirements stated in this specification.

Chemical Analysis of Aluminium and Steel:

Samples taken from the Aluminium ingots/ coils/ strands shall be chemically/ spectrographically analysed. The same shall be in conformity to the requirements stated in this specification.

ROUTINE/ACCEPTANCE TESTS:

Visual and Dimensional Check on Drums

The drums shall be visually and dimensionally checked to ensure that they conform to the requirements of this specification. Drum dimensions should confirm to IS: 1778. The flange diameter, traverse width, barrel diameter and flange thickness are to be as per relevant standard.

Visual Check for Joints, Scratches etc.

Conductor drums shall be rewound in the presence of the inspector. The inspector shall visually check for scratches, joints, etc. and that the conductor generally conforms to the requirements of this specification.

Dimensional Check of Steel and Aluminium Strands

The individual strands shall be dimensionally checked to ensure that they conform to the requirements of this specification.

Check for Lay-ratios of various Layers

The lay-ratios of various layers shall be checked to ensure that they conform to the requirements of this specification.

Breaking load test on welded Aluminium strand & Individual wires

Two Aluminium wires shall be welded as per the approved quality plan and shall be subjected to tensile load. The welded point of the wire shall be able to withstand the minimum breaking load of the individual strand guaranteed by the supplier.

- Ductility Test
- wrapping test
- Resistance test
- Galvanising Test

13. RETEST AND REJECTION : -

Each coil or spool selected for testing shall be tested for compliance with the requirements of Indian Standard Specification 398 (part-II) 1976 with latest amendment if any selected coil or spool not fulfil any of the test requirements, that particular coil or spool shall be withdrawn. In respect of each failure, two test pieces shall be selected from two different coils in the lot and subjected to the test under which the failure occurred. If either of the two retest pieces fails to pass that test, the lot concerned shall be rejected.

If samples are taken for test after stranding and if any selected reel fails in the retest, the manufacturer may test each and every reel and submit them for further inspection. All rejected materials shall be suitably marked and segregated.

14. GUARANTEED TECHNICAL PARTICULARS : -

The bidder shall fill in the guaranteed technical particulars in the Performa at Appendix-IV and submit the same with his tender, without which bid will not be considered.

15. SAG TENSION CHARTS AND SAG TEMPLATES : -

The Successful bidder shall supply each six copies of sag tension charts and sag templates in respect of each type of the steel core aluminum conductor. The Successful bidder shall also supply sag template in celluloid which shall be subject to the approval by the Owner and without involving any extra charges. The design data of the lines on which these conductors will be used are given in Appendix-III.

APPENDIX – I

<u>ACSR CONDUCTOR:</u>	<u>MOOSE</u>
1 Size of conductor:	54/7/3.53 mm
2 Stranding and wire diameter	
Aluminum	54/3.53 mm
Steel	7/3.53 mm
3 Sectional area of Aluminum (in mm ²)	528.5
4 Approximate total mass (in Kgs/KM)	2004
5 Calculated resistance at 20°C Max.: (in Ohms/Km.)	0.05552
6 Calculated breaking load of: composite conductor (in KN) (U.T.S.) (Min)	161.20 KN
Lay Rating :-	
7 Steel core	Max – 18 Min - 16
Aluminium Layers	
12 Wire Layer (Innermost Layer)	Max – 14 Min - 12
18 Wire Layer (Lay immediately beneath outside Layer)	Max -13 Min - 11
24 wire layer (outside layer)	Max -12 Min -10
8 Modulus of elasticity (in Kg / mm ²):	6860 0.7036 x 10 ⁶ Kg x CM ² (69 GN per Sq. meter)
Co-efficient of linear expansion 9 of conductor per degree centigrade.	19.3 x 10 ⁻⁶
Standard area of Cross Section in 10 Sq. mm of conductor.	597.0 mm ²
11 Diameter of complete conductor in	31.77 mm

APPENDIX – II

Solid Steel and Aluminium Wires used in Steel cored

Aluminium Conductors

		<u>MOOSE</u>	
		<u>Steel</u>	<u>Aluminium</u>
1	Diameter		
	Standard (in mm)	3.53	3.53
	Maximum (in mm)	3.6	3.55
	Minimum (in mm)	3.46	3.51
2	Cross Sectional Area of nominal Diameter Wire (in mm ²)	9.791	9.791
3	Weight (in Kg/KM)		
4	Minimum tensile strength:	As per Relevant ISS	
5	Minimum breaking load before stranding (in KN)	12.86	1.57
6	Minimum breaking load: after stranding (in KN)	12.22	1.49
7	Zinc coating of steel strands Number and duration: of dips	3 dips of 1min	
	Minimum Weight of : Coating (in gm/ m ²) (As per IS-4826 –1979)	260	
8	Maximum resistance at: (in Ohms / KM)	2.921	20°C of Aluminium strands
9	Minim Purity of aluminium rod:	99.5%	

APPENDIX – III

ACSR CONDUCTOR:	<u>MOOSE</u>
1. Conductor	Steel cored Aluminum
(a) Copper equivalent: mm ²	
(b) Stranding (in mm)	54/7/3.53
2. Normal Span.	320 Meters
Wind Span.	320 Meters
<u>Weight Span.</u>	
(a) Max.	500 Meters
(b) Min.	50 Meters
3. Wind Pressure on full project area.	52 Kgf per M ²
4. Temperature	
(a) Minimum	5 ° C
(b) Maximum	67 ° C
(c) Every day	32°C
5. Factors of safety : Minimum	
(i) Every day temperature and no wind.	4.00
(ii) Minimum temperature and 2/3 maximum wind :	2.00
(iii) Every day Temperature and full wind	2.00
This is as per Indian Electricity Rules, 1956.	
6. Relative Humidity.	
Maximum.	100 Percent
Minimum.	60 Percent
7. Isoceramic level.	100/Years
8. Number of rainy days per year.	100 days
9. Average rainfall per year	1150 mm. approx.
10. Altitude.	Less than 350 Meters

Technical parameters

<u>Sl. No.</u>	<u>Description</u>	<u>ACSR MOOSE</u>
1	Stranding and wire diameter	54Al /3.53 mm+7 Steel/3.53 mm
2	Number of Strands	
	Steel centre	1
	1st Steel Layer	6
	1st Aluminium Layer	12
	2nd Aluminium Layer	18
	3rd Aluminium Layer	24
3	Sectional area of aluminium	528.5 mm ²
4	Total sectional area	597.00 mm ²
5	Overall diameter	31.77 mm
6	Approximate weight	2004 kg/km
7	Calculated DC resistance at 20°C	0.05596 Ω/km
8	Minimum UTS	161.2 kN
9	The details of aluminium strand are as follows:	
	Minimum breaking load of strand before stranding	1.57 kN
	Minimum breaking load of strand after stranding	1.49 kN
	Maximum DC resistance of strand at 20 °C	2.921 Ω/km
10	The details of steel strand are as follows	
	Minimum breaking load of strand before stranding	12.86 kN
	Minimum breaking load of strand after stranding	12.22 kN
11	Minimum number of twist to be with stood in torsion test when tested on a gauge length of 100 times diameter of wire	18 - before stranding 16 - after stranding
12	Tolerances	
12a	Diameter of aluminium strands	Standard 3.53 mm Maximum 3.55 mm Minimum 3.51 mm
	Diameter of steel strands	Standard 3.53 mm Maximum 3.60 mm Minimum 3.46 mm
13	Lay ratio of Conductor	
13a.	Steel - 6 wire layer	Maximum 18 Minimum 16
13b.	Aluminium- 12 wire layer	Maximum 14 Minimum 12
13c.	Aluminium- 18 wire layer	Maximum 13 Minimum 11
13d.	Aluminium- 24 wire layer	Maximum 12

	Minimum	11
14	Materials composition	
14a.	Aluminium	99.5% with copper content less than 0.4%
14b.	Steel	
	Carbon	0.50 to 0.85 %
	Manganese	0.50 to 1.10 %
	Phosphorous	not more than 0.035 %
	Sulphur	not more than 0.045 %
	Silicon	0.10 to 0.35 %
14c.	Zinc for galvanising	electrolytic high grade zinc of 99.95% purity conforming to IS 209-1979.

SECTION – II

TECHNICAL SPECIFICATION FOR G.I. GROUND WIRE.

(7/3.15 mm and 7/3.66mm)

1. SCOPE :

This provides for the manufacture, testing before dispatch, supply and delivery of Ground wire for the purpose of earthing and protection of power transmission line, as per the particulars given in Appendix-I attached. The ground wire shall consist of standard galvanized steelwire.

2. STANDARDS :

The ground wire shall comply in all respect with the Indian Standard (IS) 2141-1979.

3. MATERIALS :

The material offered shall be of best quality and workmanship. The steel wires (Strands) shall be manufactured from steel produced by any suitable process. The steel wire shall not contain sulphur and phosphorous exceeding 0.040 percent each as per IS: 2141-1971.

The steel wires shall be evenly and uniformity coated with zinc complying with IS: 209-1965 specification for zinc (Retired). Only virgin zinc shall be used and reclaimed zinc is not permitted. The virgin zinc shall be of zn 99.95 percent quality.

The content of carbon shall not be more than 0.55 percent, manganese and silicon contents shall be 0.40 to 0.90 and 0.15 to 0.35 respectively.

4. SIZE AND CONSTRUCTION :

The size of ground wire shall be as given in Appendix-I. The physical properties have been given in the same Appendix. The lay of the strands shall be of lengths as given in the Appendices. The wires shall be so stranded together that when any evenly distributed pulls applied at the end of the completed strands each wire will take on equal share of the pull.

5. LENGTH OF JOINING:

The ground wire may be supplied in the standard length as per manufacturer's standard practice and such length will be specifically indicated in the tender. However random length of ground wire upto a maximum of 10 (Ten) percent may be allowed.

The length of strand which may be supplied without joints in the individual wires comprising it depends on the length of wire which may be carried by the bobbin in a normal stranding machine. The normal lengths of strand which shall be supplied without joints in individual wires, excluding welds made in the rod before drawing shall be as given in Appendix – I.

Each coil shall be warranted to contain no weld joints or splice other than in the rod before it is drawn and those permitted. The wire shall be circular and shall be free from scale or irregularities, imperfections, flow spite and other defects. The zinc coating shall be smooth even and bright.

6. TESTS AND TEST CERTIFICATES:

Ground wire shall be subjected to the tests as specified in the IS: 2141-1979 before dispatch.

All the coils of the galvanized strand shall be of the same grade, diameter and construction manufactured under similar condition shall be grounded to constitute one lot.

Samples from each lot shall be tested for ascertaining the conformity to the requirements of the ground wire specified herein. The coils selected shall be tested for length of the lay and joints. The lot shall be declared conforming to the requirements of these characteristics if all the coils are found satisfactory. One test specimen from each wire of the strand shall be drawn, from every selected coil and subjected to tensile tests, ductility test and coating test. One specimen of the completed strand from each coil shall be subjected to tensile strength. The lot shall be declared conforming to the requirements of these characteristics if the entire best specimen satisfy the relevant requirements.

Chemical Analysis: One sample shall be drawn from the lot for chemical analysis. Unless otherwise agreed to between the purchase and supplier the chemical analysis shall be carried out.

Tensile Test: The wire when tested in accordance with IS: 1521-1960 shall have minimum tensile strength specified in the Appendix – I. The tensile strength of the finished strand shall not be less than 95% of the aggregate of the single wires.

Ductility test: The wire shall be subjected to wrapping test in accordance with IS: 1755-1961. When wrapped eight times round its own diameter and on being subsequently straightened the wire shall not break or split.

Coating test: The uniformity of zinc coating shall be tested as per IS: 2633-1964. The wire shall withstand the number of dips specified in Appendix – I.

Three copies of manufacturers test certificate shall be submitted by the Successful bidder to the Owner for approval immediately after such tests have been conducted on the strands and the wire.

The Owner reserves the right to inspect the material at Manufacturer's works before dispatch.

7. PACKING AND MARKING :

The ground wire shall be supplied in non-returnable reels or drums of non-perishable or treated wood conforming to IS: 1778-1991 specification for Reels and Drums for Bare wire. Each coil shall be provided with a level fixed firmly on the inner part of the coil, bearing the following information.

- (a) Trade name, if any.
- (b) Name of manufacturer
- (c) Type of wire, size and length of wire.
- (d) Not weight of the wire.
- (e) Total weight, and
- (f) Number of lengths on the reel or drum unless otherwise agreed to between the Owner and the supplier, the stranded wire shall be supplied in 50 Kg. coil.

8. SAG AND TENSION CHARTS AND SAG TEMPLATE :

The successful bidder shall be required to submit six copies of sag templates and strings charts for different temperatures and spans, One set of charts shall be ink on tracing cloth. The design date of the lines on which the ground wire will be used are given in Appendix – II

APPENDIX – I

TECHNICAL SPECIFICATION OF GROUND WIRE

- | | | | |
|---|--------------------------------------|---|---|
| 1 | Material | : | Steel |
| 2 | Purity of material | : | Sulphur and phosphorous contents not exceeding 0.040 percent each. Carbon content not exceeding 0.55 percent. Total silicon contents shall be 0.15 to 0.35 and Manganese contents shall be 0.40 to 0.90 respectively. |
| 3 | Standing and wire diameter | : | 7/3.15 mm |
| 4 | Weight | : | 428 Kg / Km. |
| 5 | Single wire before stranding | | |
| | Diameter of wire | : | 3.15 mm |
| | Tolerance | : | + 0.060 mm
- 0.030 mm |
| | Minimum elongation in 100 mm. | : | 4 mm. |
| | Minimum breaking strength | : | 857 kg. |
| | Minimum tensile strength | : | 85.7 kgf / mm ² |
| 6 | Stranded wire length of lay | | |
| | Maximum | : | 175 mm |
| | Minimum | : | 145 mm |
| | Minimum breaking load | : | 5810 kg |
| | Over all diameter | : | 9.45 mm |
| | Modulus of elasticity | : | 1.938 x 10 ⁶ Kg/Cm ² |
| | Co-efficient of linear expansion | : | 11.50 x 10 ⁻⁶ per deg.C. |
| | D.C. resistance at 20 ⁰ C | : | 3.375 Ohms/Km. |
| 7 | Zinc coating : | | |
| | Number of one minute dips | : | Three |
| | Number of half-minute dips | : | One |

Quality of zinc	: Zn 98 IS:209/1966
Weight of coating on wire process: of galvanizing	: 275 g/m ²
8 Process of galvanizing	: Hot-dip.
Joints	: There shall be no joint in any of the wires constituting the ground wire.
9 Lengths -	
Standard length	: 1500 meters.
Tolerance on standard length	: ± 5 percent
Random lengths	: Not more than 5 percent of the lengths ordered.
10 Tests: -	
Type tests Ultimate tensile strength test.	: A sample of the finished ground wire when tested in tensile testing machine shall not fail at a stress less than 100% of UTS value of the ground wire. The length of the test sample shall be not less than 5 meters.
Electrical Tests	: As per BS : 182/1972 and BS : 3229/1960
Routine Tests	: As per clause No. 6 of IS: 2141 1968. In addition to these tests, the weight and adherence of Zinc coating tests shall be conducted as per clause 4 and 5 of IS: 4826/1968.
11 Test Reports	: Three copies of manufacturer test certificates shall be submitted by the Contracts to the Owner for approve immediately after such test have been conducted on the galvanised steel strand and the wire.

9. Overhead earth conductors:

General (7/3.66mm):

Where earth conductors are erected to provide the specified degree of lightning protection,

they shall consist of stranded galvanized steel and shall comply with IEC 888 and IEC 1089 in so far as it applies to steel wires.

Galvanizing shall comply with the requirements of IS 2141.

The arrangement of earth conductors shall be such that failure of a single conductor cannot predictably result in a fall across both bus bars in a duplicate bus bar substation.

Technical parameters for Earth Wire

SI No.	Parameter	Value	
1	Stranding and wire diameter	7/3.66mm	
2	Number of strands	1/6	
3	Total sectional area	73.65 mm ²	
4	Overall diameter	10.98mm	
5	Approximate weight	583 kg/km	
6	Calculated DC resistance at 20C	2.5 ohms/m	
7	Minimum ultimate tensile strength	68.4kN	
8	Direction of outer lay	Right hand	
9	Tolerances		
9a	Diameter	standard	3.66mm
		maximum	3.75mm
		minimum	3.57mm
9b	Lay length	standard	181mm
		maximum	198mm
		minimum	165mm
10	Steel composition Carbon	0.55%	
	Manganese	0.4 to 0.9%	
	Phosphorous	0.04%	
	Sulphur	0.04%	
	Silicon	0.1 to 0.35%	
11	Zinc for galvanizing	Electrolytic high grade zinc of 99.95% purity to 209 1979	

SECTION-III
TECHNICAL SPECIFICATION FOR DISC INSULATORS FOR SUBSTATION
AND TRANSMISSION LINE WORK

1. SCOPE:

This specification provides for design, manufacture, engineering, inspection and testing before dispatch packing and delivery FOR (destination) for Indian manufacturers of disc. Insulators as per technical requirements furnished in this specification.

These insulators are to be used in suspension and tension insulators strings for the suspension and anchoring of the conductors on EHV transmission line towers.

Following is the list of documents constituting this package.

- (i) Technical specification.
- (ii) Technical data sheet.
- (iii) Drawings of insulators

All the above volumes along with amendments there of shall be read and interpreted together. However, in case of a contradiction between the “Technical Specification” and any other volume, the provisions of this volume will prevail.

The insulators shall conform in all respects to high standards of engineering, design workmanship and latest revisions of relevant standards at the time of offer and Owner shall have the power to reject any work or material which in his judgment, is not in full accordance therewith.

2. STANDARDS:

1. Except as modified in this specification, the disc insulators shall conform to the following Indian Standards, which shall mean latest revisions and amendments. Equivalent International and Internally recognized standards to which some of these standards generally correspond are also listed below.

Sl. No.	Indian Standard	Title	International Standard.
1.	IS: 206	Method for Chemical Analysis of SlabZinc.	
2.	IS: 209	Specification for Zinc.	BS: 3436
3.	IS: 731	Porcelain insulators for overhead power lines with a normal voltage greater than 1000V	BS: 137(I&II); IEC 274 IEC 383
4.	IS: 2071 Part-(I)	Method of High Voltage Testing.	

Sl. No.	Indian Standard	Title	International Standard.
	Part-(II) Part-(III)		
5.	IS: 2121 (Part-I)	Specification of Conductors and Earthwire Accessories for Overhead Powerlines. Armour Rods, Binding wires and tapes for conductor.	
6.	IS: 2486	Specification for Insulator fittings for Overhead power lines with a nominal voltage greater than 1000V.	
	Part – I	General Requirement and Tests.	BS: 3288
	Part – II	Dimensional Requirements.	IEC: 120
	Part – III	Locking devices.	IEC: 372
7.	IS: 2629	Recommended practice for Hot Dip Galvanization for iron and steel.	
8.	IS: 2633	Testing for Uniformity of Coating of Zinc coated articles.	
9.	IS: 3138	Hexagonal Bolts & Nuts.	ISO/R 947 & ISO/R 272
10.	IS: 3188	Dimensions for Disc Insulators.	IEC: 305
11.	IS: 4218	Metric Screw Threads	ISO/R 68-1969 R 26-1963, R 262-1969 & R965-1969
12.	IS: 6745	Determination of weight of zinc Coating on zinc coated iron and steel articles.	
13.	IS: 8263	Methods of RIV Test of HV insulators.	IEC 437 NEMA Publication No.107/1964 CISPR
14.	IS: 8269	Methods for switching impulse test on HV insulators.	IEC: 506
15.		Thermal mechanical performance test and mechanical performance test on string insulator units.	IEC: 575
16	IEC	Long Rod Insulators	IEC-433

2. The standards mentioned above are available from:

Reference.	Name & Address:
BS	British Standards, British Standards Institution, 101, Penton vile Road, N-19 ND,U
IEC / CISPR	International Electro technical commission Electro Technique International. 1, Rue de verembe Geneva SWITZERLAND.
IS	Bureau of Indian Standards, Manak Bhavan, 9 Bahadurshah Zafar Marg, New Delhi- 110001, ORISSA

ISO	International Organization for Standardization. Danish Board of Standardization Dansk Standardizing Sraat Aurehoegvej-12 DK-2900 Hellestrup DENMARK.
NEMA	National Electric Manufacturers Association 1'55, East 44 th . Street New York, NY 10017 USA

3. **PRINCIPAL PARAMETERS:**

DETAILS OF DISC INSULATORS:

The Insulator strings shall consist of standard discs for use in three phases. 50 Hz effectively earthed 33/132/220 KV transmission system of OPTCL in a moderately polluted atmosphere. The discs shall be cap and pin, ball and socket type, radio interference and have characteristics as shown in Table-I and all ferrous parts shall be hot dip galvanized as per the latest edition of IS 2629. The zinc to be used for making sleeves shall be 99.95 % pure.

The size of disc insulator, minimum creepage distance the number to be used in different type of strings, their electromechanical strength and mechanical strength of insulator string along with hardware shall be as follows:

PRINCIPAL PARAMETERS OF THE DISC INSULATORS:-

Sl. No.	Type of String.	Size of disc. Insulator (mm)	Minimum creepage distance of each disc (mm),	No. of standard Discs 220KV	Electro- mechanical strength of insulator string fittings (KN)
1.	Single suspension	255 x 145	320	1x14	90 KN Normal Disc Insulator
2.	Double suspension.	255 x 145	320	2x14	90 KN Normal Disc Insulator
3	Single suspension	255 x 145	430	1x14	90 KN Antifog Insulator
4	Double suspension.	255 x 145	430	2x14	90 KN Antifog Disc Insulator
5	Single Tension	280x145	430	1x15	120 KN Antifog Disc Insulator
6	Double Tension	280x145	430	2x15	120 KN Antifog Disc Insulator
7	Single Tension	305x170	475	1x15	160 KN Antifog Disc Insulator
8	Double Tension	305x170	475	2x15	160 KN Antifog Disc

					Insulator
5	Single Suspension	280x145	430	1x15	120 KN Antifog Disc Insulator
6	Double Suspension	280x145	430	2x15	120 KN Antifog Disc Insulator

SPECIFICATION DRAWINGS:

The specification in respect of the disc insulators are described. These specification for information and guidance of the Bidder only. The drawings to be furnished by the supplier shall be as per his own design and manufacture and in line with the specification.

GENERAL TECHNICAL REQUIREMENTS:

Porcelain:

The porcelain used in the manufacture of the shells shall be ivory white nonporous of high dielectric, mechanical and thermal strength, free from internal stresses blisters, laminations, voids, forgone matter imperfections or other defects which might render it in any way unusable for insulator shells. Porcelain shall remain unaffected by climatic conditions ozone, acid, alkalis, zinc or dust. The manufacturing shall be by the wet process and impervious character obtained by through verification.

The insulator shall be made of highest grade, dense, homogeneous, wet-process porcelain, completely and uniformly vitrified throughout to produce uniform mechanical and electrical strength and long life service. The porcelain shall be free from warping, roughness, cracks, blisters, laminations, projecting point's foreign particles and other defects, except those within the limits of standard accepted practice. Surfaces and grooves shall be shaped for easy cleaning. Shells shall be substantially symmetrical.

Porcelain glaze:

Surface to come in contact with cement shall be made rough by sand glazing. All other exposed surfaces shall be glazed with ceramic materials having the same temperature coefficient of expansion as that of the insulator shell. The thickness of the glaze shall be uniform throughout and the colour of the glaze shall be down. The Glaze shall have a visible luster and smooth on surface and be capable of satisfactory performance under extreme tropical climatic weather conditions and prevent ageing of the porcelain. The glaze shall remain under compression on the porcelain body throughout the working temperature range.

METAL PARTS:

Cap and Ball Pins:

Ball pins shall be made with drop forged steel caps with malleable cast iron. They shall be in one single piece and duly hot dip galvanized. They shall not contain parts or pieces joined together welded, shrink fitted or by any other process from more than one piece of materials. The pins shall be of high tensile steel, drop forged and heat-treated. The caps

shall be cast with good quality black heart malleable cast iron and annealed. Galvanizing shall be by the hot dip process with a heavy coating of zinc of very high purity. The bidder shall specify the grade composition and mechanical properties of steel used for caps and pins. The cap and pin shall be of such design that it will not yield or distort under the specified mechanical load in such a manner as to change the relative spacing of the insulators or add other stresses to the shells. The insulator caps shall be of the socket type provided with nonferrous metal or stainless steel cotter pins and shall provide positive locking of the coupling.

Security Clips:

The security ceps shall be made of phosphor bronze or of stainless steel.

FILTER MATERIAL:

Cement to be used, as a filler material be quick setting, fast curing Portland cement. It shall not cause fracture by expansion or loosening by contraction. Cement shall not react chemically with metal parts in contact with it and its thickness shall be as small and as uniform as possible.

MATERIALS DESIGN AND WORKMANSHIP:

GENERAL:

- (I) All raw materials to be used in the manufacture of these insulators shall be subject to strict raw material quality control and to stage testing/ quality control during manufacturing stage to ensure the quality of the final end product. Manufacturing shall conform to the best engineering practices adopted in the field of extra high voltage transmission. Bidders shall therefore offer insulators as are guaranteed by them for satisfactory performance on Transmission lines.
- (II) The design, manufacturing process and material control at various stages be such as to give maximum working load, highest mobility, best resistance to corrosion, good finish elimination of sharp edges and corners to limit corona and radio interference voltages.

INSULATOR SHELL:

The design of the insulator shells shall be such that stresses due to expansion and contraction in any part of the insulator shall not lead to deterioration. Shells with cracks shall be eliminated by temperature cycle test followed by mallet test. Shells shall be dried under controlled conditions of humidity and temperature.

METAL PARTS:

- (I) The pin and cap shall be designed to transmit the mechanical stress to the shell by compression and develop uniform mechanical strength in the insulator. The cap shall be circular with the inner and outer surfaces concentric and of such design that it will not yield or distort under loaded conditions. The head portion of the pinball shall be suitably designed so that when the insulator is under tension the stresses are uniformly distributed over the pinhole portion of the shell. The pinball shall move freely in the cap socket either during assembly of a string or during erection of a string or when a string

is placed in position.

- (II) Metal caps shall be free from cracks, seams, shrinks, air holes, blowholes and rough edges. All metal surfaces shall be perfectly smooth with no projecting part or irregularities, which may cause corona. All load bearing surfaces shall be smooth and uniform so as to distribute the loading stress uniformly. Pins shall not show any microscopically visible cracks, inclusions and voids.

GALVANIZING:

All ferrous parts, shall be hot dip galvanized in accordance with IS: 2629. The zinc to be used for galvanizing shall conform to grade Zn 99.5 as per IS: 209. The zinc coating shall be uniform, smoothly adherent, reasonably light, continuous and free from impurities such as flux, ash, rust stains, bulky white deposits and blisters. Before ball fittings are galvanized, all die flashing on the shank and on the bearing surface of the ball shall be carefully removed without reducing the designed dimensional requirements.

CEMENTING:

The insulator design shall be such that the insulating medium shall not directly engage with hard metal. The surface of porcelain shall be coated with resilient paint to offset the effect of difference in thermal expansions of these materials. High quality Portland cement shall be used for cementing the porcelain to the cap & pin.

SECURITY CLIPS (LOCKING DEVICES)

The security clips to be used as locking device for ball and socket coupling shall be 'R' shaped hump type to provide for positive locking of the coupling as per IS: 2486 (Part-IV). The legs of the security clips shall allow for spreading after installation to prevent complete withdrawal from the socket. The locking device shall be resilient, corrosion resistant and of sufficient mechanical strength. There shall be no possibility of the locking device to be displaced or be capable of rotation, which is placed in position, and under no circumstances shall it allow separation of insulator units and fittings. 'W' type security clips are also acceptable. The hole for the security clip shall be counter sunk and the clip shall be of such design that the eye of the clip may be engaged by a hot line clip puller to provide for disengagement under energized conditions. The force required for pulling the clip into its unlocked position shall not be less than 50 N (5 kg.) or more than 500 N (50 kgs.)

MARKING:

Each insulator shall have the rated combined mechanical and electrical strength marked clearly on the porcelain surface. Each insulator shall also bear symbols identifying the manufacturer, month, and year of manufacture. Marking on porcelain shall be printed, not impressed, and shall be applied before firing.

BALL AND SOCKET DESIGNATION:

The dimensions of the ball and sockets for 70 and 90 KN discs shall be of 16 mm and for 120 KN and 160 KN discs shall be of 20 mm designation in accordance with the standard dimensions stated in IS: 2486 (Part-II).

DIMENSIONAL TOLERANCE OF INSULATOR DISCS:

It shall be ensured that the dimensions of the disc insulators are within the limits specified below:

A.

Sl. No.	Diameter of Disc (mm)	Standard in mm	Maximum	Minimum
1.	70 KN/90 KN & 120 KN	255/255 & 280	As per IS	As per IS
2.	160 KN	305	As per IS	As per IS

B.

Sl. No.	Ball to Ball spacing Between Discs (mm)	Standard in mm	Maximum	Minimum
1.	70 KN/90 KN/120 KN	145	As per IS	As per IS
2.	160 KN	170	As per IS	As per IS

GUARANTEED TECHNICAL PARTICULARS

FOR ANTIFOG DISC INSULATORS

Sl. No.	DESCRIPTION	70 KN	90 KN	120KN	160 KN
1.	Manufacture's name & address				
2	Type of Insulator	Ball & socket	Ball & socket	Ball & socket	Ball & socket
3	Size of ball & socket	16B	16B	20	20
4	Dimensions				
(a)	Disc diameter	255	255	280	305
(b)	Unit spacing	145	145	145	170
(c)	Creepage distance of the single insulator-mm	430	430	430	475
5	Electro-mechanical strength of single insulator-kN	70	90	120	160
6	Materials of shell	Porcelain	Porcelain	Porcelain	Porcelain
7.	Electrical value				
7.1	Power frequency Withstand voltage disc				
(a)	Dry-kV (rms)	80	80	85	90
(b)	Wet-kV (rms)	45	45	50	50

7.2	Power frequency flash over voltagesingle-disc (a) Dry-kV (rms) (b) Wet-kV (rms)	85 50	85 50	90 55	95 55
7.3	Impulse withstand voltage 1.2/50 micro second 1.Positive –kV(peak) 2.Negative –kV (peak)	125 125	125 125	130 130	135 135
7.4	Impulse Flashover voltage 1.2/50 micro second 1.Positive –kV(peak) 2.Negative –kV (peak)	135 130	135 130	140 135	145 140

*** Tolerance as per relevant IS (Latest edition).**

INTERCHANGEABILITY:

The insulators inclusive of the ball and socket fittings shall be of standard design suitable for use with hardware fittings of any make conforming to relevant Indian Standards.

CORONA AND RIV PERFORMANCE:

All surfaces shall be even, smooth, without cuts, abrasions or projections. No part shall be subject to excessive localized pressure. The metal parts and porcelain shall not produce any noise-generating corona under all operating conditions.

SUITABILITY FOR LIVE LINE MAINTENANCE:

The insulator shall be compatible for use with hot line or live line maintenance techniques so that usual hot line operation can be carried out with easy speed and safety.

FREEDOM FROM DEFECTS:

Insulators shall have none of the following defects:

- 1) Ball pin shake.
- 2) Cementing defects near the pin like small blow holes, small hair cracks lumps etc.
- 3) Sand fall defects on the surface of the insulator.

INSULATOR STRINGS

TYPE AND RATING:

The insulator strings shall be formed with standard discs described in this specification for use on 3 phases 220 KV 50 Hz effectively earthed systems in an atmosphere with pollution level as indicated in project synopsis. Suspension insulator strings for use with suspension/tangent towers are to be fitted with discs 70/90 KN EMS rating while tension insulator strings for use with Anchor/ Tension towers are to be fitted with discs of 120 KN / 160 KN EMS level rating.

STRING SIZE:

The sizes of the disc insulator, the number to be used in different types of strings, their electro-mechanical strength and minimum nominal creep age distance shall be as given in

Table (Principal parameter of the disc Insulator) in this specification.

STRING CHARACTERISTICS

The characteristics of the complete string shall be as follows:

Sl. No.	Description.	Suspension	Tension
		220kV	220KV
I	Switching surge withstand voltage (dry & wet) KV peak.	-	-
Ii	Lighting impulse withstand voltage (dry)KV Peak.	1050	1050
Iii	Power frequency without voltage (wet) KV r.m.s.	460	460
Iv.	Corona extinction voltage level KV rms	176	176
v.	Max. RIV for comp. Etc. strong includingcorona rings at 156 KV (rms). ... Hours clamps etc. at 1.1. Times maximum knee to ground voltage (micro volts).	500	500
vi.	Mechanical failing load for each sting(kgf)	11500	15500
Vii.	No deformation load for each string (kgf)	7705	10385
Viii.	Max. Voltage across any disc.	13%	13%

Insulator units after assembly shall be concentric and coaxial within limits as permitted by Indian Standards.

The strings design shall be such that when units are coupled together there shall be contact between the shell of one unit and metal of the adjacent unit.

4. **DETAILS OF SOLID CORE LONG ROD INSULATORS:**

1. The insulator shall consist of standard-discs for a three-phase 50 Hz effectively earthed 220 KV transmission system heavily polluted atmosphere. The insulator shall be ball and socket type.
2. The size of long rod insulator, minimum creepage distance, the number to be used in different type of strings, their electromechanical strength and mechanical strength of insulator string along with hardware shall be as follows:

Sl. No.	Type of string.	Size of long rod insulator (mm)/(Unit) 220 KV	Minimum creepage distance (mm)220 KV	No.of unit 220 KV	Electromechanical strength of insulator(KN) 220 KV
1.	Single suspension	210X2030	6125	2	90 KN
2.	Double suspension	210X2030	6125	4	90 KN

3.	Single tension.	215X2550	7130	2	160 KN
4.	Double Tension.	215X2550	7130	4	160 KN

5. **SPECIFICATION DRAWINGS:**

The specification in respect of the long rod insulators indicated above is given at Annexure-II. These specification is for information and guidance of the bidder only. The drawings to be furnished by the supplier shall be as per his own design and manufacture and shall be in line with the specification.

6. **GENERAL TECHNICAL REQUIREMENT**

PORCELAIN:

The porcelain used in the manufacture of the shell shall be ivory white, nonporous of high dielectric, mechanical and thermal strength free from internal stress blisters and thermal strength from internal stresses blisters, laminations, voids, foreign matter. Imperfections or other defects, which might render it in any way unsuitable for insulator shells. Porcelain shall remain unaffected by climatic conditions, ozone, acid alkalis, and zinc of dust. The manufacturing shall be by the wet process and impervious character obtained by through verification.

PORCELAIN GLAZE:

Surfaces to come in contact with cement shall be made rough by sand glazing. All other exposed surfaces shall be glazed with ceramic materials having the same temperature coefficient of expansion as that of the insulator shell. The thickness of the glaze shall be uniform throughout and the colour of the glaze shall be brown. The glaze shall have a visible luster and smooth on surface and be capable of satisfactory performance under extreme tropical climatic weather conditions and prevent ageing of the porcelain. The glaze shall remain under compression on the porcelain body throughout the working temperature range.

1. METAL PARTS:

Cap and Ball pins:

Twin Ball pins shall be made with drop forged steel and caps with malleable cast iron. They shall be in one single piece and duly hot dip galvanized. They shall not contain parts or pieces joined together, welded, shrink fitted or by any other process from more than one piece of material. The pins shall be of high tensile steel, drop forged and heat malleable cast iron and annealed. Galvanizing shall be by the hot dip process with a heavy coating of zinc of very high purity with minimum of 6 dips. The bidder shall specify the grade, composition and mechanical properties of steel used for caps and pins.

SECURITY CLIPS:

The security clips shall be made of phosphor bronze or of stainless steel.

FILLER MATERIAL:

Cement to be used as a filler material shall be quick setting, for curing Portland cement. It shall not cause fracture by expansion or loosening by contraction. Cement shall not react chemically with metal parts in contact with it and its thickness shall be as small and as uniform as possible.

7. MATERIAL DESIGN AND WORKMANSHIP:

1. GENERAL:

- i) All raw materials to be used in the manufacture of these insulators shall be subject to strict raw materials quality control and to stage testing quality control during manufacturing stage to ensure the quality of the final end product. Manufacturing shall conform to the best engineering practices adopted in the field of extra high voltage transmission. Bidders shall therefore offer insulators as are guaranteed by them for satisfactory performance on Transmission lines.
- ii) The design, manufacturing process and material control at various stages be such as to give maximum working load, highest mobility, best resistance to corrosion good finish, elimination of sharp edges and corners to limit corona and radio interference voltage

2. INSULATOR SHELL:

The design of the insulator shell shall be such that stresses due to expansion and contraction in any part of the insulator shall not lead to deterioration. Shells with cracks shall be eliminated by temperature cycle test followed by temperature cycle test followed by mallet test. Shells shall be dried under controlled conditions of humidity and temperature.

3. METAL PARTS:

- i) The twin ball pin and cap shall be designed to transmit the mechanical stresses to the shell by compression and develop uniform mechanical strength in the insulator. The cap shall be circular with the inner and outer surfaces concentric and of such design that it will not yield or distort under loaded conditions. The head portion of the insulator or is under tension the stresses are uniformly distributed over the pinhole portion of the shell. The pinball shall move freely in the cap socket either during assembly of a string or during erection of a string or when a string is placed in position.
- ii) Metal caps shall be free from cracks, seams, shrinks, air holes, blowholes and rough edges. All metal surfaces shall be perfectly smooth with no projecting parts or irregularities which may cause corona. All load bearing surfaces shall be smooth and uniform so as to distribute the loading stresses uniformly. Pins shall not show any macroscopically visible cracks, insulations and voids.

4. GALVANIZING:

All ferrous parts shall be hot dip galvanized six times in accordance with IS: 2629. The zinc to be used for galvanizing shall conform to grade Zn 99.5 as per IS: 209. The zinc coating shall be uniform, smoothly adherent, reasonably light, continuous and free from impurities such as flux ash, rust stains, bulky white deposits and blisters. Before ball

fittings are galvanized, all die flashing on the shank and on the bearing surface of the ball shall be carefully removed without reducing the designed dimensional requirements.

7.4.1. **CEMENTING:**

The insulator design shall be such that the insulating medium shall not directly engage with hard metal. The surfaces of porcelain and coated with resilient paint to offset the effect of difference in thermal expansions of these materials.

5. **SECURITY CLIPS (LOCKING DEVICES):**

The security clips to be used as locking device for ball and socket coupling shall be 'R' shaped hump type to provide for positive locking of the coupling as per IS: 2486 (Part-IV). The legs of the security clips shall allow for sore adding after installation to prevent complete withdrawal from the socket. The locking device shall be resilient corrosion resistant and of sufficient mechanical strength. There shall be no possibility of the locking device to be displaced or be capable of rotation when placed in position and under no circumstances shall it allow separation of insulator units and fitting 'W' type security clips are also acceptable. The hole for the security clip shall be countersunk and the clip shall be of such design that the eye of the clip may be engaged by a hot line clip puller to provide for disengagement under energized conditions. The force required for pulling the clip into its unlocked position shall not be less than 50 N (5 Kgs.) or more than 500N (50 Kgs.)

6. **BALL AND SOCKET DESIGNATION:**

The dimensions of the balls and sockets for 80 KN long rod insulators shall be of 16mm and for 120 KN shall be of 20mm designation in accordance with the standard dimensions stated in IS: 2486 (Part-III).

7. **DIMENSIONAL TOLERANCE OF INSULATORS DISCS**

It shall be ensured that the dimensions of the long rod insulators are within the limits as per relevant IEC/ISS.

8. **TESTS (FOR DISC INSULATORS) :**

1. The following tests shall be carried out on the insulator string and disc insulators.

2. **TYPE TEST:**

This shall mean those tests, which are to be carried out to prove the design, process of manufacture and general conformity of the material and product with the intents of this specification. These tests shall be conducted on a representative number of samples prior to commencement of commercial production. The Bidder shall indicate his schedule for carrying out these tests.

3. **ACCEPTANCE:**

This shall mean these tests, which are to be carried out on samples taken from each lot offered for pre-dispatch inspection for the purpose of acceptance of the lot.

4. **ROUTINE TESTS:**

This shall mean those tests, which are to be carried out on each insulator to check the requirements, which are likely to vary during production.

5. **TESTS DURING MANUFACTURE:**

Stage tests during manufacture shall mean those tests, which are to be carried out during the process of manufacture to ensure quality control such that the end product is of the designed quality conforming to the intent of this specification.

6. **TEST VALUE:**

For all type and acceptance tests the acceptance values shall be the value guaranteed by the bidder in the guaranteed technical particulars of the acceptance value specified in this specification of the relevant standard whichever is more stringent for that particular test.

7. **TEST PROCEDURE AND SAMPLING NORMS:**

The norms and procedure of sampling for the above tests shall be as per the relevant Indian Standard or the internationally accepted standards. This will be discussed and mutually agreed to between the supplier and Owner before placement of order. The standards and normal according to which these tests are to be carried out are listed against each test. Where a particular test is a specific requirement of this specification, the norms and procedure for the same shall be as specified in Annexure-IV attached hereto as mutually agreed to between the supplier and the Owner in the quality assurance programme.

8. **TYPE TESTS:**

The following type test shall be conducted on a suitable number of individual unit components, materials or complete strings.

8.8.1. On the complete insulator string with hardware fittings.

- | | |
|---|----------------------------|
| a. Power frequency voltage withstand test with corona control rings and under wet condition | BS:137(Part-I) |
| b. Switching surge voltage withstand test under wet condition (400 only) | |
| c. Impulse voltage withstand test under dry condition. | IEC: 383 |
| d. Impulse voltage flashover test under dry condition. | |
| e. Voltage distribution test. | |
| f. Corona & RIV test under dry condition | As per this specification. |
| g. Mechanical strength test. | As per this specification. |
| h. Vibration on Insulators | |

8.8.2.

- | | |
|--------------------------------|---------|
| a. Verification of dimensions. | IS: 731 |
|--------------------------------|---------|

- | | |
|---|----------|
| b. Thermal mechanical performance test: | IEC:575 |
| c. Power frequency voltage withstand and flashover
(I) dry (ii) wet. | BS: 173 |
| d. Impulse voltage withstand flashover test (dry) | IEC: 383 |
| e. Visible discharge test (dry) | IS:731 |
| f. RIV test (dry) | IS:8263 |

8.8.3. All the type tests given under clause No.6.8.1 above shall be conducted on single suspension and Double Tension insulator string along with hardware fittings

9. ACCEPTANCE TESTS:

8.9.1. For insulator:

- | | |
|---|------------------------------|
| a) Visual examination | : IS:731 |
| b) Verification of dimensions. | : IS:731 |
| c) Temperature cycle test. | : IS:731 |
| d) Galvanizing test. | : IS:731 |
| e) Mechanical performance test. | : IEC:575 |
| f) Test on locking device for ball and socket Coupling. | : IEC:575 |
| g) Eccentricity test. | : As per this specification. |
| h) Electro-mechanical strength test. | : |
| i) Puncture test. | : IS:731 |
| j) Porosity test. | : IS:731 |

10. ROUTINE TESTS:

For insulators:

- | | |
|-----------------------------|-----------|
| a) Visual inspection. | : IS:731 |
| b) Mechanical routine test. | : |
| c) Electrical routine test. | : IEC:383 |

11. TEST DURING MANUFACTURE:

On all components as applicable.

- | | |
|---|------------------------------|
| a) Chemical analysis of zinc used for Galvanizing. | : |
| b) Chemical analysis, mechanical and Metallographic test and magnetic particle Inspection for malleable castings. | = |
| c) Chemical analysis, hardness test and Magnetic particle inspection for forgings. | : As per this specification. |
| d) Hydraulic Internal Pressure tests on shell. | : |
| e) Crack detection test for metal parts. | : |

12. ADDITIONAL TEST:

The Owner reserves the right for carrying out any other tests of a reasonable nature at the works of the supplier/ laboratory or at any other recognized laboratory/ research institute in addition to the above mentioned type, acceptance and routine tests at the cost of the Owner to satisfy that the material complies with the intent of this specification.

13. CO-ORDINATION FOR TESTING:

For insulator strings, the supplier shall arrange to conduct testing of their disc insulators with the hardware fittings to be supplied to the Owner by other suppliers. The supplier is also required to guarantee overall satisfactory performance of the disc insulator with the hardware fittings.

NOTE:

In respect of electrical tests on a complete string consisting of insulators and hardware guarantee of values of responsibility of testing shall be with hardware manufacturer of RIV corona and voltage distribution test and with insulator manufacturer for all other tests.

14. TEST CHARGES AND TEST SCHEDULE:

TYPE TEST:

The insulator offered shall be fully type tested as per this specification. In case the equipment of the type and design offered, has already been type tested in an independent test laboratory. The bidder shall furnish four sets of type test reports alongwith the offer. These tests must not have been conducted earlier than five years. The Owner reserves the right to demand repetition of some or all type tests in the presence of Owners' carrying representative. For this purpose the bidder may quote unit rates for carrying out each type test. These prices shall be taken into consideration for bid evaluation. For any change in the design/type already type tested and the design/type offered against this specification, Owner reserves the right to demand repetition of tests without any extra cost.

ACCEPTANCE AND ROUTINE TEST:

All acceptance and routine tests as stipulated herein shall be carried out by the supplier in the presence of Owner's representative.

Immediately after finalization of the programme of type/ acceptance/ routine testing, the supplier shall give sufficient advance intimation to the Owner to enable him to depute his representative for witnessing the tests.

For type tests involving tests on a complete insulator string with hardware fittings, the Owner will advise the supplier of the hardware fittings to provide the necessary fittings to the place of the test.

In case of failure of the complete string in any type tests, the supplier whose product has failed in the tests, shall get the tests repeated at his cost. In case of any dispute, assessment of the Owner as to the items that has caused the failure in any of the type tests shall be final and binding.

9. INSPECTION:

- i. Owner and its representative shall at all times be entitled to have access to the works and to all places of manufacturer where insulators are manufactured and the supplier shall afford all facilities to them for unrestricted inspection of the works, inspection of materials, inspection of manufacturing process of insulators and for conducting necessary tests as specified herein.
- ii. The supplier shall keep the Owner informed in advance of the time of starting and of progress of manufacture of insulators in its various stages so that arrangements could be made for inspection.
- iii. No material shall be dispatched from its point of manufacture unless the materials has been satisfactorily inspected and tested.
- iv. The acceptance of any quantity of insulators shall in no way relieve the supplier of his responsibility for meeting all the requirement of this specification and shall not prevent subsequent rejection, if such insulators are later found to be defective.

IDENTIFICATION MARKING:

Each unit of insulator shall be legibly and indelibly marked with the trade mark of the supplier, the year of manufacture, the guaranteed combined mechanical and electrical strength in kilo-newtons abbreviated by 'KN' to facilitate easy identification and proper use.

The marking shall be on porcelain for porcelain insulators. The marking shall be printed and not impressed and the same shall be applied before firing.

10. QUALITY ASSURANCE PLAN:

The bidder hereunder shall invariably furnish following information along with his offer, failing which the offer shall be liable for rejection.

- i. Statement giving list of important raw materials, names of sub-suppliers for the raw materials, list of standards according to which the raw material are tested, list of tests normally carried out on raw materials in presence of bidder's representative, copies of testcertificates.
- ii. Informations and copies of test certificates as in (i) above in respect of bought out materials.
- iii. List of manufacturing facilities available.
- iv. Level of automation achieved and lists of area where manual processing exists.
- v. List of areas in manufacturing process, where stage inspections are normally carried out inquality control and details of such tests and inspection.
- vi. Special features provided in the equipment to make it maintenance free.
- vii. List of testing equipping available with the bidder for final testing of equipment specified and test plant limitation, if any, vis-à-vis the type, special, acceptance and routine tests specified in the relevant standards. These limitations shall be very clearly brought out in schedule of deviations from specified test requirements.

The supplier shall within 30 days of placement of order submit the following information to the owner.

- i. List of raw material and the names of sub-suppliers selected from those furnished along with the offer.

POST INSULATORS:

Post insulator shall conform in general to IS 2544, IEC 168 and IEC 815.

Constructional features:

Post type insulators shall consist of a porcelain part permanently secured in a metal base to be mounted on the supporting structures. They shall be capable of being mounted upright and be designed to withstand any shocks to which they may be subjected to by the operation of the associated equipment. Only solid core insulators will be acceptable. Porcelain used shall be homogeneous, free from lamination, cavities and other flaws or imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vitrified, tough and impervious to moisture.

Glazing of the porcelain shall be of uniform brown in colour, free from blisters, burrs and other similar defects.

The insulator shall have alternate long and short sheds with aerodynamic profile. The shed profile shall also meet the requirements of IEC 815 for the specified pollution level. When operated at normal rated voltage there shall be no electric discharge between conductor and insulators which would cause corrosion or injury to conductors or insulators by the formation of substance produced by chemical action. The design of the insulators shall be such that stresses due to expansion and contraction in any part of the insulator shall not lead to deterioration. All ferrous parts shall be hot dip galvanized in accordance with the latest edition of IS 2633, and IS 4579. The zinc used for galvanizing shall be grade Zn 99.95 as per IS 209. The zinc coating shall be uniform, adherent, smooth, reasonably bright, continuous and free from imperfections such as flux ash, rust stains, bulky white deposits and blisters. The metal parts shall not produce any noise generating corona under the operating conditions. Flat washer shall be circular of a diameter 2.5 times that of bolt and of suitable thickness. Where bolt heads/nuts bear upon the beveled surfaces they shall be provided with square tapered washers of suitable thickness to afford a seating square with the axis of the bolt. Bidder shall make available data on all the essential features of design including the method of assembly of shells and metal parts, number of shells per insulator, the manner in which mechanical stresses are transmitted through shells to adjacent parts, provision for meeting expansion stresses, results of corona and thermal shock tests, recommended working strength and any special design or arrangement employed to increase life under service conditions.

11. TEST DETAILS:

1. VOLTAGE DISTRIBUTION TEST:

The voltage across each insulator unit shall be measured by sphere gap method. The result obtained shall be converted into percentage and proportionate correction be applied as to give a total of 100% distribution. The voltage across any disc. Not exceed the values given in String Characteristics Table of this Specification.

2. CORONA EXTINCTION VOLTAGE TEST (DRY):

The sample assembly when subjected to power frequency voltage shall have a corona extinction voltage of not less than the value specified at String characteristics table under dry condition. There shall be no evidence of corona on any part of the sample when all possible sources of corona are photographed in a darkened room.

3. RIV TEST (DRY):

Under the conditions as specified in (2) above, the insulator string along with complete hardware fittings shall have a radio interference voltage level below 500 micro volts at one MHz when subjected to 50 Hz AC voltage of 1.1 times maximum time to ground voltage under dry condition. The test procedure shall be in accordance with IS: 8263.

4. The complete insulator string along with its hardware fitting excluding arcing horn corona controlling/grading ring and suspension assembly/dead end assembly shall be subject to a load equal to 50% of the specified minimum ultimate tensile strength (UTS) which shall be increased already rate to 68% of the minimum UTS specified. The load shall be held for five minutes and then removed. After removal of the load, the string component shall not show any visual deformation and it shall be possible to disassemble them by hand, Hand tools may be used to remove cotter pins and loosen the nuts initially. The string shall then be reassembled and loaded to 50% of UTS and the load shall be further increased at a steady rate till the specified minimum UTS and held for one minute. No fracture should occur during this period. The applied load shall then be increased until the failing loads reached and the value recorded.

5. VIBRATION TEST:

The suspension string shall be tested in suspension mode, and tension string in tension mode itself in laboratory span of minimum 30 meters. In the case of suspensions string a load equal to 600 Kg. shall be applied along with the axis of the suspensions string by means of turn buckle. The insulators string along with hardware fittings and two sub conductors throughout the duration of the test vibration dampers shall not be used on the test span. Both the sub-conductors shall be vertically vibrated simultaneously at one of the resonance frequencies of the insulator string (more than 10Hz) by means of vibration inducing equipment. The amplitude of vibration at the antipode point nearest to the string shall be measured and the same shall not be less than 120.4 being the frequency of vibration. The insulator strings shall be vibrated for five million cycles then rotated by 90 deg and again vibrated for 5 million cycles without any failure, after the test, the disc insulators shall be examined for looseness of pins and cap or any crack in the cement. The hardware fittings shall be examined to fatigue fatter and mechanical strength test. There shall be no deterioration of properties of hardware components and disc insulators after the vibration test. The disc insulators shall be subjected to the following tests as per relevant standards.

<u>Test.</u>	<u>Percentage of disc To be tested.</u>
a) Temperature cycle test followed by Mechanical performance test.	60 40
b) Puncture test (for porcelain insulator only)	

6. CHEMICAL ANALYSIS OF ZINC USED FOR GALVANIZING:

Samples taken from the zinc ingot shall be chemically analyzed as per IS: 209. The purity of zinc shall not be less than 99.95%.

7. TEST FOR FORGINGS:

The chemical analysis hardness tests and magnetic particle inspection for forgings will be as per the internationally recognized procedures for these tests. The sampling will be based on heat number and heat treatment batch. The details regarding test will be as discussed and mutually agreed to by the supplier and Owner in quality assurance programme.

1. TEST ON CASTING:

The chemical analysis mechanical and metallographic tests and magnetic particle inspection for castings will be as per the internationally recognized procedures for these tests. The samplings will be based on heat number and heat treatment batch. The details regarding test will be as discussed and mutually agreed to by the supplier and Owner in quality assurance programme.

2. HYDRAULIC INTERNAL PRESSURE TEST ON SHELLS:

The test shall be earned out on 100% shells before assembly. The details regarding test will be as discussed and mutually agreed to by the suppliers and Owner in Quality Assurance Programme.

3. THERMAL MECHANICAL PERFORMANCE TEST:

The thermal mechanical performance test shall be carried out on minimum 15 number of disc insulators units as per the procedure given in IEC 575. The performance of the insulator unit shall be determined by the same standard.

4. ECCENTRICITY TEST:

The insulator shall be vertically mounted on a future using dummy pin and socket. A vertical scale with horizontal slider shall be used for the axial run out. The pointer shall be positioned in contact with the bottom of the outermost petticoat of the disc. The disc insulators shall be rotated with reference to the fixture and the slider shall be allowed to move up and down on the scale but always maintaining contact with the bottom of the outer most petticoats. After one full rotation of the disc the maximum and minimum position the slider has reached on the scale can be found out. Difference between the above two readings shall satisfy the guaranteed value for axial run out.

Similarly using a horizontal scale with veridical slider the radial run out shall be measured. The slider shall be positioned on the scale to establish contact with the circumference of the disc insulator and disc insulator rotated on its future always maintaining the contact. After one full rotation of the disc the maximum and minimum position the slider has reached on the scale can be found out. Difference between the above two readings shall satisfy the guaranteed value for axial run out.

5. CRACK DETECTION TEST:

Crack detection test shall be carried out on each ball and pin before assembly of disc unit. The supplier shall maintain complete record of having conducted such tests on

each and every piece of ball pin the bidder shall furnish full details of the equipment available with him for crack test and also indicate the test procedure in detail.

6. **Tubular bus conductors:**

General:

Aluminum used shall be grade 63401 WP conforming to IS 5082. The tube shall be seamless and shall be manufactured by either of the following processes:

- Hot extrusion process through die and mandrel (Hollow billet process). Heat treatment shall be carried out after hot extrusion of tube.
- Bridge extrusion process and then cold drawn. Heat treatment shall be carried out after cold drawing of tube.

Constructional features:

For outside diameter (OD) and thickness of the tube there shall be no minus tolerance, other requirements being as per IS 2678 and IS 2673.

The aluminum tube shall be supplied in suitable cut length to minimize wastage.

Technical parameters:

Sl.No	Size	4" IPS (EH type)	3"IPS (EH type)	4.5"IPS (EH type)
1	Outer diameter (mm)	114.20	88.9	120.0
2	Thickness (mm) :	8.51	7.62	12.0
3	Cross-sectional area (sq mm)	2825.61	2373.63	4071.5
4	Weight (kg/m)	7.7	6.44	10.993
5	Chemical composition			
	i. Cu	0.05 max	0.05 max	0.05 max
	ii. Mg	0.4 to 0.9	0.4 to 0.9	0.4 to 0.9
	iii. Si	0.3 to 0.7	0.3 to 0.7	0.3 to 0.7
	iv. Fe	0.5 max	0.5 max	0.5 max
	v. Mn	0.03 max	0.03 max	0.03 max
	vi. Al	Remainder	Remainder	Remainder
6	Minimum ultimate Tensile strength Kg/Sq mm	20.5	20.5	20.5
7	Temp co-eff of resistance	0.00364 per Deg C		
8	Minimum electrical conductivity at 20 deg C	55% of IACS		
9	Modulus of Elasticity	6700 Kg/sq mm		

7. Post insulators:

Post insulators shall conform in general to IS 2544, IEC 168 and IEC 815.

Constructional features

Post type insulators shall consist of a porcelain part permanently secured in a metal base to be mounted on the supporting structures. They shall be capable of being mounted upright and be designed to withstand any shocks to which they may be subjected to by the operation of the associated equipment. Only solid core insulators will be acceptable.

Porcelain used shall be homogeneous, free from lamination, cavities and other flaws or imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vitrified, tough and impervious to moisture.

Glazing of the porcelain shall be of uniform brown in colour, free from blisters, burrs and other similar defects.

The insulator shall have alternate long and short sheds with aerodynamic profile. The shed profile shall also meet the requirements of IEC 815 for the specified pollution level.

When operating at normal rated voltage there shall be no electric discharge between conductor and insulators, which would cause corrosion or injury to conductors, or insulators by the formation of substance produced by chemical action.

The design of the insulators shall be such that stresses due to expansion and contraction in any part of the insulator shall not lead to deterioration.

All ferrous parts shall be hot dip galvanized in accordance with the latest edition of IS 2633, and IS 4579.

The zinc used for galvanizing shall be grade Zn 99.95 as per IS 209. The zinc coating shall be uniform, adherent, smooth, reasonably bright, continuous and free from imperfections such as flux ash, rust stains, bulky white deposits and blisters.

The metal parts shall not produce any noise generating corona under the operating conditions.

Flat washer shall be circular of a diameter 2.5 times that of bolt and of suitable thickness. Where bolt heads/nuts bear upon the beveled surfaces they shall be provided with square tapered washers of suitable thickness to afford a seating square with the axis of the bolt.

Bidder shall make available data on all the essential features of design including the method of assembly of shells and metals parts, number of shells per insulator, the manner in which mechanical stresses are transmitted through shells to adjacent parts, provision for meeting expansion stresses, results of corona and thermal shock tests, recommended working strength and any special design or arrangement employed to increase life under service conditions.

Services to be performed by the equipment being furnished:

The equipment shall be able to withstand forces due to wind load on the equipment and approach conductor and due to short circuit, all forces considered together.

The Successful bidder shall submit detailed calculations proving the satisfactory performance of the equipment under short circuit conditions to meet the layout requirements.

Technical Parameters

SI No.	Parameter	245kV	33kV
1	Type	Confirming to IEC 273	
2	Voltage class (kV)	245	36
3	Dry and wet one minute withstand voltage (kVrms)	460	70
4	Dry lightning impulse withstand voltage (kVp)	±1050	±250
5	Wet switching surge withstand voltage (kVp)	NA	NA
6	Max. RIV at corona extinction voltage (microvolts)	500	NA
7	Corona extinction voltage (kVrms)	156 (min)	
9	Total minimum cantilever strength (kg)	not < 800	not < 600
10	Minimum torsional moment	As per IEC 273	
11	Total height of insulator (mm)	2300	325
12	PCD (mm) top/bottom	127/254	76/76
13	No. of bolts top/bottom	4/8	4/8
14	Diameter of bolt holes (mm) top/bottom	M16/18	M16/18

15	Pollution level as per IEC 815	Heavy	Heavy
16	Minimum total creepage distance (mm)	6125	900

If corona extinction voltage is to be achieved with the help of corona ring or any other similar device, the same shall be deemed to be included in the scope of the Supplier.

8. Spacers

General

Spacers shall conform to IS 10162. Spacers are to be located at a suitable spacing to limit the short circuit forces and also to avoid snapping of sub conductors during short circuit conditions.

Constructional features

No magnetic material shall be used in the fabrication of spacers except for GI bolts and nuts.

Spacer design shall be made to take care of fixing and removing during installation and maintenance. The design of the spacers shall be such that the conductor does not come in contact with any sharp edge.

SECTION-IV

TECHNICAL SPECIFICATION FOR HARDWARE FITTINGS.

SUITABLE FOR GALVANISED STEEL STRANDED GROUNDWIRE (7/3.15mm and 7/3.66 mm) ACCESSORIES AND POWER CONDUCTOR ACSR MOOSE.

1. SCOPE:

This Specification covers design (if required), manufacture, testing at manufacturer's Works, supply and delivery of GSS), power conductor and ground wire accessories, insulator and hardware fittings for string insulators suitable for use in 220 KV Overhead transmission lines and sub-stations of OPTCL. The hardware to be supplied shall be as per approved drawings of OPTCL. Any change there of shall be with due permission of Authorized Personnel of OPTCL. The firm shall submit his drawings for approval of OPTCL and only after which the manufacturing shall be started.

The materials/equipment offered, shall be complete with all components, which are necessary or usual for the efficient performance and satisfactory maintenance. Such part shall be deemed to be within the scope of contract.

2. STANDARDS:

The materials covered under this Specification shall comply with the requirement of the latest version of the following standards as amended upto date, except where specified otherwise.

i)	IS:2486 Part-II & III	: Insulator fitting for overhead power lines with a nominal voltage greater than 1,000 volts.
ii)	IS:2121 Part I & II	Conductor & earth wire accessories for overhead power lines.
iii)	IS:9708	Stock Bridge Vibration Dampers on overhead power lines.
iv)	IS:2633	Method of testing of uniformity of coating on zinc coated articles
v)	IS:209	Specification for Zinc.
vi)	BS:916	Specification for Hexagonal bolts and nuts.

3. MATERIALS AND DESIGN:

Aluminum and aluminum alloys, malleable iron and forged steel, having required mechanical strength, corrosion resistance and machinability depending on the types of application for which accessories / fittings are needed, shall be employed.

In manufacture of the accessories / fittings, the composition of the aluminum alloys used shall be made available to Employer if required for verification.

The materials offered shall be of first class quality, workmanship, well finished and approved design. All castings shall be free from blow-holes, flaws, cracks of other defects and shall be smooth, close grained and true forms and dimensions. All machined surfaces should be free, smooth and well finished.

Metal fittings of specified material for conductor and earth wire accessories and string insulator fittings are required to have excellent mechanical properties such as strength, toughness and high resistance against corrosion. All current carrying parts shall be so

designed and manufactured that contact resistance is reduced to the minimum.

All bolts, nuts, bolt-heads shall be the white worth's standard thread. Bolt heads and nuts shall be hexagonal. Nuts shall be locked in an approved manner. The treads in nuts and tapped holes shall be cut after galvanizing and shall be well fabricated and greased. All other treads shall be cut before galvanizing. The bolt treads shall be undercut to take care of increase in diameter due to galvanizing. All nuts shall be made of materials to Clause 4.8 of IS: 1367 (latest edition) with regard to its mechanical properties.

The general design conductor and earth wire accessories and insulator fittings shall be such as to ensure uniformity, high strength, free from corona formation and high resistance against corrosion even in case of high level of atmosphere pollution.

All hooks, eyes, pins, bolts, suspension clamps and other fittings for attaching to the tower or to the line conductor or to the earth wire shall be so designed that the effects of vibration, both on the conductor and the fittings itself, are minimized.

Special attention must be given to ensure smooth finished surface throughout. Adequate bearing area between fittings shall be provided and point or line contacts shall be avoided.

All accessories and hardwares shall be free from cracks, shrinks, slender air holes, burrs or rough edges.

The design of the accessories and hardwares shall be such as to avoid local corona formation or discharge likely to cause interference to tele-transmission signals of any kind.

4. GALVANISING :

All ferrous parts of conductor and ground wire accessories and insulator hardwares shall be galvanized in accordance with IS: 2629-Recommended Practice for hot dip galvanizing of iron and steel or any other equivalent authoritative standards. The weight of zinc coating shall be determined as per method stipulated in IS: 2633 for testing weights, thickness and uniformity of coating of hot dip galvanized articles or as per any other equivalent authoritative standards. The zinc used or galvanization shall conform to grade zn 98 of IS:209. The galvanized parts shall withstand four (4) dips of 1 minute each time while testing uniformity of zinc coating as per IS: 2633. Spring washers shall be electro-galvanized

5. ACCESSORIES FOR CONDUCTOR AND GROUND WIRE, MID SPAN COMPRESSION JOINTS: FOR ACSR- MOOSE AND GROUNDWIRE OF 7/3.15 and 7/3.66 mm.

The Mid-Span Joints for conductor and earth wire shall be of compression type. The conductor mid- span joints shall comprise of outer aluminium sleeve of extruded aluminium (99.5% purity) and inner sleeve HDG Steel. All filler plug shall also be provided. The ground wire mid-span joints shall be of HDG steel. The sleeves shall be of circular shape suitable for compression into hexagonal shape.

The compression type mid-span straight joints shall be suitable for making joints in the ACSR MOOSE conductor or in the galvanized steel stranded ground wire.

The joints shall be so designed that when installed no air space is left within the finished joints. The joints shall have the conductivity as specified in relevant Clause.

The joints shall conform to IS: 2121 (latest edition) unless specified otherwise. The details of the joints both suitable for ACSR- Moose and ground wire are given in the technical particulars.

The inner and outer diameters and lengths of the offered joints before and after compression shall be clearly shown in the drawings.

6. VIBRATION DAMPER FOR ACSR MOOSE AND GROUND WIRE(7/3.15 and 7/3.66 mm)

Vibration Damper having 4 resonance frequency characteristic commonly called 4R Damper shall be offered. The Damper shall eliminate fatigue on the conductor due to vibration and damp out the vibration effectively so that no damage due to vibration is caused to conductor / ground wire / string. The dampers are proposed to be used at all tension locations and also at suspension locations. One or more dampers are proposed to be used on tension/suspension locations depending upon the span.

Bidder shall also recommend the number of damper required to effectively damp out conductor or ground wire vibration for different values of span lengths and the distance of fixation.

Vibration dampers shall be of approved design. The clamps of the vibration dampers shall be made of aluminum alloy, so designed as to prevent any damage while fixing on the conductor during erection or in continued operation. The fastening bolts should be approved by the Owner. The spring washers should be electro-galvanized and of minimum 2 mm thickness.

The messenger cable shall be made from high tensile strength steel strands in order to prevent subsequent drop of weight in service.

Clamping bolts shall be provided with self-locking nuts as designed to prevent corrosion of the threads. All ferrous parts including the messenger cable shall be hot dip galvanized. The end of the messenger cable shall be effectively sealed to prevent corrosion.

The vibration dampers and its attachment shall have smooth surface so that no corona occurs on them.

The clamps of the stock bridge vibration dampers shall be so designed that in case of loosening of the bolt or changing free parts of the clamp, it does not allow the damper to disengage from the conductor.

7. REPAIR SLEEVE FOR ACSR MOOSE AND GROUNDWIRE :

Compression type repair sleeves shall be offered to provide reinforcement for conductor with broken or damaged aluminum strands/galvanized steel ground wire broken in damaged steel strands. The repair sleeve shall be designed to make good a conductor of which not more than one-sixth (1/6th) of the strands in the outermost layer and damaged or severed. The repair sleeves after compression should present a smooth surface.

8. SUSPENSION CLAMPS : FOR GROUND WIRE

Suspension clamps of suitable size are required for holding the galvanized steel stranded ground wire at suspension points. The suspension clamps shall be suspended from the

lower hanger or 'D' belt of 16 mm. dia. And should, therefore, be supplied with a suitable attached that would allow the clamps to swing freely both in the transverse and longitudinal direction. The clamps shall be so designed that the effect of vibration both on the ground wire and the fittings itself is minimum.

The clamps shall be manufactured and finished so as to avoid sharp radial of curvature, ridges which might lead to localized pressure and damage the ground wire in service.

The clamps shall be made of heat treat malleable iron one Eye hook made of forced steel. The entire assembly shall be hot dip galvanized.

The clamping surface shall be smooth and formed to support the ground wire on long easy curves to take care or required steel vertical and horizontal angles.

The clamps shall permit the ground wire to slip before the failure of the latter occurs. The leg of U- bolt holding the keeper piece of the clamps shall be kept sufficient long and shall be provided with threads, nuts and locking nuts for fixing the flexible earthing bond between the suspension clamps and tower structures.

9. TENSION CLAMPS (DEAD AND ASSEMBLY) FOR GROUND WIRE:

Compression type dead end assembly of G.S.S. ground wire shall be required for use on the tension towers. The dead end assembly shall be supplied with complete jumper terminals, nuts and bolts suitable link pieces between the steel clevis and tower strain plates so as to provide sufficient flexibility not less than that of G.S.S. ground wire and the tensile strength not less than 90% that of the G.S.S. ground wire.

The assemblies shall comprise of compression type dead end clamps and one anchor shackle made of forged steel. The entire assembly shall be hot dip galvanized.

One of bolt holding joint per terminal of dead end assemblies shall be kept sufficiently long and threaded and shall be provided with nuts, washers and locking nuts for fixing the flexible earthing bond between the dead-end clamp and tower structures.

10. BONDING PIECES (FLEXIBLE COPPER EARTHING BOND FOR EARTH WIRE 7/3.15 and 7/3.66 mm)

The bidder shall offer flexible copper earthing bonding pieces for connecting the ground wire suspension and tension clamps and tower legs suitable for earthing.

Each bond piece shall have suitable compression type galvanized steel lug or thimble on either end for making connections to clamp and tower legs. The size, strength, etc. of the bonding piece is given in this Specification.

11. INSULATOR HARDWARES:

The insulator disc hardware and string assemblies to be offered by the bidder shall be suitable to meet the requirement given in the specific technical particulars as detailed hereinafter.

Hardwares for suspension and tension insulator shall be suitable for insulator with normal pin shank diameter of 20 mm. in case of tension string unit and 16mm. for suspension string unit.

Each insulator string shall generally include the following hardware components.

Single Suspension Set.	Double Suspension Set.
a) Ball Hook	a) Ball Hook.
b) tower side arcing horn	b) Socket clevis with R-Type security clip-3 Nos.
c) Socket Eye with R-Type security clip.	c) Yoke Plate-2 Nos.
d) Line side arcing horn.	d) Tower side arcing horns-2Nos.
e) Armour grip suspension clamps	e) Ball clevis – 2 Nos. f) Line side arcing horns-2Nos. g) Clevis Eye. h) Armour Grip Suspension Clamp.
Single Tension Set :	Double Tension Set :
a) Anchor Shackle.	a) Anchor Shackle.
b) Ball Eye.	b) Chain Link
c) Tower side arcing horn.	c) Yoke Plate – 2 Nos.
d) Socket Clevis with R-Type security clip.	d) Tower side arching horn.
e) Line side arcing horn	e) Ball Clevis – 2 Nos.
f) Compression type dead end clamp.	f) Socket Clevis with R- Type security clip – 2 Nos.
	g) Line side arcing horns. h) Compression type dead end clamps.

12. CLAMP:

ARMOUR GRIP SUSPENSION CLAMPS:

Armour Grip Suspension Clamp shall consist of 2 neoprene insert, one set of armour rods made of aluminum alloy, two aluminum housing having inner profile matching with the profile of the armour rods page and supporting strap made of aluminum alloy. The A.G. type suspension clamp shall be designed, manufactured and finished as to have a suitable shape without sharp edges at the end and to hold the respective conductor properly. It should, however, have sufficient contact surface to minimize damage due to fault current. The clamp shall be of Armour Grip Type.

The A.G. Type suspension clamp shall permit the conductor to slip before the occurrence of failure of the conductor and shall have sufficient slip strength to resist the conductor tension under broken wire conditions. The clamp shall have slip strength of not less than 15 % of respective conductors.

TENSION CLAMPS:

The Tension Clamps shall be made out of aluminum alloy and of compression type suitable for MOOSE conductor. The tension clamps shall not permit slipping or damage to failure of the complete conductor or any part thereof at a load less than 90% of the ultimate strength of conductor. The mechanical efficiency of tension / clamps shall not be affected by method of erection involving come / along or similar clamps or

tension stringing operation during or after assembly and erection of tension clamp itself. The tension clamp shall be of a design that will ensure unrestricted flow of current without use of parallel groove clamps.

The clamps shall be as light as possible.

ARCING HORNS:

Each hardware assembly shall have provision for attaching arcing horns of both adjustable and non/adjustable type across the suspension and tension strings or tower side. However each hardware assembly shall be provided with arching horn of fixed type on line side only.

UNIVERSAL JOINTING COMPOUND:

BENDEX-HV' Universal jointing compound which is a chemically inert compound to be used as filler for the compression joints and dead end clamps to be supplied.

13. TESTS, TEST CERTIFICATE AND PERFORMANCE REPORTS:

The fittings and accessories for the power conductor and G.S.S. ground wire, insulator and hardwares shall be tested in accordance with IS: 2121, IS: 2486, IS: 9708 (For V Dampers), BS: 916 for hexagonal bolts and nuts or any other authoritative equivalent standards. Six sets of type and routine test certificates and performance reports are to be submitted by the bidder.

The Owner however, reserves the right to get all the tests performed in accordance with the relevant I.S. Specification as Acceptance Test in presence of Owner's representatives.

The bidder shall clearly state the testing facilities available in the laboratory at his Works and his ability to carry out the tests in accordance with this Specification. All the specified tests shall be carried out without any extra cost.

- Acceptance Test for power conductor and G.S.S. ground wire accessories.
- a) Visual examination
 - b) Dimensional verification
 - c) Failing load test
 - d) Slip strength test (for clamps)
 - e) Electrical resistance test
 - f) Resonance frequency test (for vibration dampers)
 - g) Fatigue test (for vibration dampers)
 - h) Mass pull off test (for vibration dampers)
 - i) Galvanizing test.

ACCEPTANCE TEST FOR HARDWARES:

- a) Dimensional verification.
- b) Ultimate tensile test.
- c) Slip strength test.
- d) Electrical resistance test.
- e) Heating cycle test
- f) Breaking strength of full string assembly.

g) Galvanizing test.

**SPECIFIC TECHNICAL REQUIREMENTS FOR CONDUCTOR ACCESSORIES
AND INSULATOR HARDWARES**

<u>Conductor</u>	<u>Moose</u>	<u>GSS ground wire</u>
Type	ACSR Moose	Ground wire.
Material	Aluminum conductor steel reinforced.	Galvanized stranded steel wire
Strand & Wire diameter.	all.54/3.53mm steel-7/3.53mm resp	7/3.15 mm. and 7/3.66 mm
Weight per Km.	2004Kg/Km.	426Kg/Km. and 583Kg/Km
Overall diameter	31.7 mm	9.4mm. and 10.98 mm 3.375 Ohms/KM
D.C. Resistance at 20 deg. C when corrected to standard weight.	0.05552 Ohms/KM.	
Minimum Breaking load/Ultimate tensile strength.	16120 Kg	5710 Kg. and 10580 Kg
Maximum working tension at minimum temperature & 2/3 full wind.	4325 Kg.	1393 Kg.
Maximum Sag at maximum temperature & no wind.	9240 mm.	5150mm.

DISC Insulator (for suspension & tension Insulator strings) (220 KV)

<u>Disc Insulators</u>	<u>Suspension</u>	<u>Tension</u>
Type	Ball & Socket	Ball & Socket. 20mm. Alt.
Ball size	16mm. Alt. B	B/20mm
Diameter	(IS:2486 Pt.II)	(IS:2486 Pt.II)
Spacing	255 mm.	280 mm
E.M.	145 mm.	170mm.
Strength	120 KN,	160 KN.

String Arrangement:

GENERAL REQUIREMENT FOR POWER CONDUCTOR & GROUND WIRE:

ACCESSORIES:

	<u>Single Suspension</u>	<u>Single Tension</u>	<u>Double Suspension</u>	<u>Double Tension</u>
(a) No. of insulator discs.	20	20	2X14	2X14
(b) Length of string assembly (mm)	2340	3003	2243	3082

GENERAL REQUIREMENTS					
POWER CONDUCTOR AND GROUND WIRE ACCESSORIES					
A)	MID-SPAN COMPRESSION JOINTS				
		Suitable for ACSR Moose		Suitable for G.S.S. groundwire 7/3.15 and 7/3.66 mm.	
	i) Type	Compression		Compression	
	ii) Material	Extruded Aluminium		Extruded aluminium.	
	a) Outer sleeve				
	b) Inner sleeve	Steel (galvanized)		Steel (Galvanized)	
		Before Compression	After Compression	Before Compression	After Compression
	iii) Dimension of Compression joint for Aluminium part.	Outer dia: 38mm Inner Dia: 23mm. Minimum length: 610mm. Minimum weight 1.2 kg. (approx)	Adjacent Size 32mm. Diagonal Size: 37mm.		
	iv) Dimension of compression joint for Steel Part	Outer dia: 18mm Inner dia. 9.3mm Adjacent Size: 15.1mm Minimum Length: 203 mm. Minimum weight: 0.28Kg (app.)	Adjacent size: 15.1mm. 10mm. Minimum	Outer dia. 18mm. Inner dia : 9.3mm size : 17.4mm Length 203mm.	Adjacent Size: Diagonal
	v) Minimum failing load.	95% of ultimate tensile strength of conductor		95% of ultimate tensile strength of groundwire	
	vi) Electrical resistance 20 Deg. C	75% of measured resistance of the equivalent length of Conductor.			
	vii) Galvanizing :				

a) Ferrous Parts.	Hot-dip galvanized (HDG)	Hot dip galvanized.
b) No. of dips 4 dips for 1 minute withstand.	4 dips	4 dips
viii) Minimum Corona formation voltage	110% of maximum line to ground voltage	

B) VIBRATION DAMPERS:

(SUITABLE FOR ACSR CONDUCTOR: MOOSE AND G.S.S. GROUND WIRE 7/3.15 and 7/3.66 mm.)

- i) Type : 4R Stock Bridge Type
- ii) Distance between conductors: 74.5 mm. & axis of the Vibration Damper.
- iii) Messenger Cable : 130 Kg/mm sq. quality (19 strands)
- iv) Bolt size : 16 mm. (dia.)
- v) Slip strength of messenger Cable: 500 Kgs.
- vi) Mass pull-of: As per I.S.S.

C) REPAIR SLEEVES:

SUITABLE FOR ACSR MOOSE CONDUCTOR AND G.S.S. GROUND WIRE:

	<u>Suitable for ACSR Moose.</u>	<u>Suitable for G.S.S. Ground wire.</u>
i. Type	Compression	Compression.
ii. Material	Extruded aluminum.	Steel
iii. Min. failing load	95% of UTS of conductor.	95% of UTS of ground wire.
iv. Length	279 mm.	200 mm (150 mm. min.)
v. Dimension :		
a. After compression	21mm	11.5 mm
i. Adjacent side		
b. Before Compression	21mm	11.5 mm
i. Outer diameter 38/48mm.		
ii. Inner diameter 23/40mm		
vi. Electrical Resistance at 20 deg. C	Not more than 75% of the resistance of equivalent length of conductor.	
vii. Galvanising		Hot – dip galvanized
Ferrous parts		
No. of dips for one-minute stand.		4 dips

D) SUSPENSION CLAMP:

FOR GROUND WIRE 7/3.15 and 7/3.66 mm

- i) Type : Envelop type
- ii) Material : Forged Steel / NCL.

- iii) **Minimum slip strength** : 25% of UTS of ground wire.
- iv) **Dimension** :
- (a) **Overall length** : 230mm
- (b) **Inner dia. (before Compression).** : 10mm.
- (c) **Outer diameter (Before compression).** : 18mm.
- (d) **After Compression** :
- Adjacent** : 15.1 mm.
- Diagonal side** : 7.4mm.
- (e) **Galvanizing** :
- (f) **Ferrous parts.** : Hot-dip galvanized.
- (i) **No. of dips for one-Minute withstand.** : 4 dips

E) BONDING PIECES:

- a) **material** : flexible copper bond (37/7/0.417 mm. tinned copper flexible stranded cable).
- b) **Length** : Not less than 750 mm.
- c) **Bolt size** : 16mm x 40 mm.
- d) **Copper area.** : 34 sq.mm.
- e) **Thickness of long** : 6 mm.
- f) **Material for connecting socket.** : Tinned Brass

F) INSULATOR HARDWARES:

A) String hardware : Material and strength

	Description of item.	Material	UTS
1	Bolt hook	Forged Steel	11,500 Kgs (90 KN)
2	Anchor Shackle	Forged Steel	15,500 Kgs (120 KN)

3	Socket Eye Horn Holder.	Forged Steel	11,500 Kgs (90 KN)
4	Socket Clevis.	Forged Steel	15,500 Kgs.
5	Ball Clevis	Forged Steel	15,500 Kgs.
6	Clevis Eye	Forged Steel	15,500 Kgs.
7	Socket Eye.	Forged Steel	15,500 Kgs.
8	Bottom / Top Yoke plate :		
	Double suspension	Mild Steel	11500 Kgs
	Double Tension	Mild Steel	15,500 Kgs.
9	Arcing Horn	Mild Steel	
10	Suspension Clamp.	Aluminum Alloy and Neoprene.	
11	Tension Clamp	All Alloy & Steel	11500 Kgs
12	Ball Pin	High tensile offorged steel (hot-dip galvanized)	90% of UTS conductor.
13	Security Clip	Brass (R-Type)	
	Minimum failing load	Single Suspension	11500
	String (KN)	Single Tension	11500 / 15500
		Double Suspension	11500
		Double Tension	11500 / 15500

B) CLAMPS:

	<u>Single suspension string</u>	<u>Single tension string</u>	<u>Double suspension string</u>	<u>Double tension string.</u>
Type	AGS Type	Compression Type	AGS Type	Compression Type
Material	Aluminium Alloy and neoprene	Aluminium Alloy and Steel	Aluminium Ally and Neoprene	Aluminium Alloy and Steel
Minimum slip strength	Not less than 15%	90% of UTS of conductor	Not less than 15% of UTS of conductor	90% of UTS of conductor
Minimum failing load (kg)	11,500	90% of UTS of conductor	11,500	90% of UTS of conductor

III). Suspension assembly: armour grip clamp.

1. The armour grip suspension clamp shall comprise of retaining strap, support housing, elastomerinserts with aluminum reinforcements and AGS preformed rod set.
2. Elastomer insert shall be resistant to the effects of temperature up to 85 deg. C, ozone, Ultraviolet radiation and other atmospheric contaminants likely to be encountered in service. The physical properties of the elastomer shall be of approved standard. It shall be electrically shielded by a cage of AGS preformed rod set. The

elastomer insert shall be so designed that the curvature of the AGS rod shall follow the contour of the neoprene insert.

3. The AGS preformed rod set shall be as detailed above in general except that the length of the AGS preformed rods shall be such that it shall ensure sufficient slipping strength and shall not introduce unfavorable stress on the conductor under all operating conditions.

IV). Fasteners: bolts, nuts & washers:

1. All bolts and nuts shall conform to IS-6639 – 1972. All bolts and nuts shall be galvanized. All bolts and nuts shall have hexagonal heads, the heads being truly concentric, and square with the shank, which must be perfectly straight.
2. Bolts upto M16 and having length upto ten times the diameter of the bolt should be manufactured by cold forging and thread rolling process to obtain good and reliable mechanical properties and effective dimensional control. The shear strength of bolt for 5.6 grade should be 310 Mpa minimum as per IS-12427. Bolts should be provided with washer face in accordance with IS-1363 Part-I to ensure proper bearing.
3. Fully threaded bolts shall not be used. The length of the bolt shall be such that the threaded portion shall not extend into the place of contact of the component parts.
4. All bolts shall be threaded to take the full depth of the nuts and threaded enough to permit the firm gripping of the component parts but not further. It shall be ensured that the threaded portion of the bolt protrudes not less than 3 mm and not more than 8 mm when fully tightened. All nuts shall fit and be tight to the point where shank of the bolt connects to the head.
5. Flat washers and spring washers shall be provided wherever necessary and shall be of positive lock type. Spring washers shall be electro-galvanized. The thickness of washers shall conform to IS-2016-1967.
6. The bidder shall furnish bolt schedules giving thickness of components connected, the nut and the washer and the length of shank and the threaded portion of the bolts and size of holes and any other special details of this nature.
7. To obviate bending stress in bolt, it shall not connect aggregate thickness more than three time its diameter.
8. Bolts at the joints shall be so staggered that nuts may be tightened with spanners without fouling.
9. Fasteners of grade higher than 8.8 are not to be used and minimum grade for bolts shall be 5.6.

GENERAL:

1. All ferrous parts including fasteners shall be hot dip galvanized, after all machining has been completed. Nuts may however be tapped (threaded) after galvanizing and the threads oiled. Spring washers shall be electro-galvanized. The bolt threads shall be undercut to take care of the increase in diameter due to galvanizing. Galvanizing shall be done in accordance with IS-2629- 1985 and shall satisfy the tests mentioned in IS 2633-1986. Fasteners shall withstand four dips while spring washers shall withstand three dips of one-minute duration in the standard Preece test. Other

- galvanized materials shall be guaranteed to withstand at least six successive dips each lasting one minute under the Standard Preece test for galvanizing.
2. The zinc coating shall be perfectly adherent of uniform thickness, smooth, reasonably bright, continuous and free from imperfections such as flux, ash, rust stains, bulky white deposits and blisters. The zinc used for galvanizing shall be of grade Zn 99.95 as per IS 209-1979.
 3. Pin balls shall be checked with the applicable “G)” gauges in at least two directions, one of which shall be across the line of die flashing and the other 90 deg. to this line. ‘NO GO’ gauges shall not pass in any direction.
 4. Socket ends, before galvanizing shall be of uniform contour. The bearing surface of socket ends shall be uniform about the entire circumference without depressions or high spots. The internal contours of socket ends shall be concentric with the axis of the fittings as per IS 2486/IEC-120. The axis of the bearing surfaces of socket ends shall be coaxial with the axis of the fittings. There shall be no noticeable tilting of the bearing surfaces with the axis of the fittings.
 5. All current carrying parts shall be so designed and manufactured that contact resistance is reduced to minimum.
 6. Welding of aluminum shall be by inert gas shielded tungsten arc or inert gas, shielded metal arc process. Welds shall be clean, sound, smooth, and uniform without overlaps, properly fused and completely sealed. There shall be no cracks, voids incomplete penetration, incomplete fusion, under-cutting or inclusions Porosity shall be minimized so that mechanical properties of the aluminum alloys are not affected. All welds shall be properly finished as per good engineering practices.

Electrical Design:

The normal duty and heavy duty suspension, light duty, normal duty and heavy duty tension insulator sets shall all comply with the technical requirements of schedule C (below) and satisfy the test requirements stated in Section-7.

Mechanical design:

The mechanical strength of the insulators and insulator fittings shall be as stated in Schedule-C (below).

The design shall be such that stresses due to expansion and contraction in any part of the insulator shall not lead to the development of defects.

Insulating material shall not engage directly with hard metal. All fixing materials shall be of approved quality, shall be applied in an approved manner and shall not enter into chemical action with the metal parts or cause fracture by expansion in service. Where cement is used as a fixing medium, cement thickness shall be as small and even as possible and proper care shall be taken to correctly center and locate the individual parts during cementing.

Technical Specification for Design, Supply and Testing of Hard ware fittings.

Type tests:

The following type tests shall be conducted on hardware fittings.

A. On suspension hardware fittings only.

- (a) Magnetic power loss test.
- (b) Clamp slip strength Vs torque
- (c) Mechanical strength test.
- (d) On one test on elastomer.

B. On Tension hard ware fittings only.

- Electrical resistance test for Dead end assembly. IS 2486 (Part-I) 1971
- (a) Heating cycle test for dead end assembly. IS 2486 (Part-I) 1971
- (b) Slip strength test for dead end assembly. IS 2486 (Part-I)
- (c) Mechanical strength test.

C. On both suspension and tension hardware fittings.

- (a) Visual examination. IS-2486 (Part-I) 1971
- (b) Verification of dimension. IS-2486 (Part-I) 1971
- (c) Galvanizing / electroplating test. IS-2486 (Part-I) 1971
- (d) Mechanical strength test of each component (Including corona control ring/grading ring and arcing horn)
- (e) Mechanical strength test of welded joint.
- (f) Mechanical strength test for corona Control ring/ grading ring and arcing horn. BS-3288 (Part-I)
- (g) Test on locking device for ball and socket Coupling. IEC – 3721984
- (h) Chemical analysis, hardness tests, grain size, Inclusion rating and magnetic particle inspection for forging/casting.

D. On suspension hardware fittings only.

- (a) Clamp slip strength versus torque test for suspension clamp.
- (b) Shore hardness test of elastomer cushion for AG suspension clamp.
- (c) Bend test for armour rod set. IS-2121 (Part-I)
- (d) Resilience test for armour rod set. IS-2121 (Part-I)
- (e) Conductivity test for armour rod set. IS-2121 (Part-I)

E. On tension hardware fittings only

	Unit.	37/4.00 mm ²
MID SPAN COMPRESSION JOINTS FOR CONDUCTORS.		
Weight of the joint.	Kg.	1.27
Slipping strength.	KN	129.6
Resistance of the completed joint.	Ohms.	0.000027
Materials of the joints specify alloy type and its aluminum contents.		6201
Before compression dia of sleeve.	mm	

(a) Inner diameter.		31+/-0.5
(b) Outer diameter.		48+/-1.0
Dimensions after compression.	mm	
(a) Corner to corner.		46+/-0.5
(b) Surface to surface.		40+/-0.5
Length of the sleeve.	mm	
(a) Before compression.		500+/-5.0
(b) After compression.		540+/-5.0
Compression pressure.	Tone	100
Whether designed for intermittent or continuous compression.		Continuous compression.
Minimum corona extinction voltage under dry condition.	Kv	154
Radio interference voltage under conditions.	Micro volt.	Below 1000
REPAIR SLEEVE FOR CONDUCTOR		
Weight of the sleeve.	Kgs.	0.63
Before compression dia of sleeve.		
(a) Inner diameter.	mm	31.05
(b) Outer diameter.	mm	48.10
Dimensions after compression.		
(a) Corner to corner.	mm	48.05
(b) Surface to surface.	mm	40.05
Length of sleeve.		
(a) Before compression.	mm	279.50
(b) After compression.	mm	300.50
Compression pressure.	Tone.	100
Minimum corona extinction voltage under dry condition.	Kv.	154
Radio interference voltage under condition.	Microvolt.	Below 1000

(a) Slip strength test for dead end assembly. IS-2121 (Part-I)

All the acceptance tests stated at clause shall also be carried out on composite insulator unit, except the eccentricity test at clause. In addition to these, all the acceptance tests indicated in IEC 1109 shall also be carried out without any extra cost to the owner.

F. For hardware fittings.

- (a) Visual examination. IS-2121 (Part-I)
 (b) Proof & test.

G. Tests on conductor accessories.

H. Type tests.

I. Mid span compression joint for conductor and earth wire.

- (a) Chemical analysis of materials.
 (b) Electrical resistance tests. IS-2121 (Part-II) 1981 clause 6.5 & 6.6
 (c) Heating cycle test. IS-2121 (Part-II) 1981 clause 6.5 & 6.6
 (d) Slip strength test. IS-2121 (Part-II) 1981 clause 6.5 & 6.6

- (e) Corona extinction voltage test (dry)
- (f) Radio interference voltage test (dry)

J. Repair sleeve for conductor.

- (a) Chemical analysis of materials.

VIBRATION DAMPER FOR CONDUCTOR.

Vibration Damper for AAC 37/4.00 mm	Unit.		
Total weight of the damper.	Kgs.	4.5	
Weight of each damper mass.	Kgs.	Left.	Right.
Resonance frequencies.		1.6	2.2
1. First frequency.	Hz	12+/- 1	18+/- 2
2. Second frequency.	Hz	28+/- 2	36+/- 2
Dimension of each damper mass.	Mm	55 Ox165	60 Ox195
Material of:		Cast iron hot dip galvanized.	
1. Damper mass.		High tensile galvanized steel wire.	
2. Messenger cable.			
No. of strands in messenger cable strands.		19	
Lay ratio of messenger cable strands.		9-11	
Min tensile strength of messenger cable.	Kg./ Sq.mm	135	
Miss pull-off strength.	KN	5	
Clamping force.	Kg.m	7	
Slipping strength of the damper clamp.	KN		
1. Before fatigue test.		2.5	
2. After fatigue test.		2.0	
Magnetic power loss per vibration damper.	Watts.	1 watt at 500 amps.	
Min. corona extinction voltage under dry conditions.	Kv.	154	
Radio interference voltage under dry condition 1MHz, at 154 KV.	Microvolt.	Below 1000	
Percentage variation in reactance after fatigue test in comparison with that before the fatigue test.	%	20	

SECTION – V

TECHNICAL SPECIFICATION CLAMPS AND CONNECTORS

1. SCOPE:

This specification covers design, manufacture, assembly, testing at manufacturer's works, supply and delivery at site of all terminal connectors of 220KV equipment and all other clamps and dropper connectors required for the switch yard as per approved lay out and system design.

2. STANDARDS:

The terminal connectors under this specification shall conform strictly to the requirements of the latest version of the following standards as amended up-to-date, except where specified otherwise.

- | | | |
|------|----------|--|
| i) | IS: 5561 | Power Connectors. |
| ii) | IS:617 | Aluminium & Aluminium Alloy |
| iii) | IS: 2629 | Recommended Practice for hot dip galvanizing of iron and steel. |
| iv) | IS: 2633 | Method of testing uniformity of coating of zinc coated articles. |

The materials conforming to any other authoritative standards which ensure equal or better performance shall also be acceptable. The salient point of these specifications and points of difference between these and the above specifications, shall be clearly brought out in the bid.

3. MATERIAL & WORKMANSHIP:

The terminal connectors shall be manufactured from Aluminium Silicon Alloy and conform to designation A6 of IS: 617 (latest edition)

The connectors shall be of best quality and workmanship, well finished and of approved design. Specific materials for clamps and connectors should have high current carrying capacity, high corrosion resistance and be free from corona formation.

All connectors or its components to be connected with ACSR conductor shall be of compression type having aluminium purity not less than 99.5%.

All bus bar clamps shall be made preferably from forged aluminium of purity not less than 99.5%. The thickness and contact surface should be maintained in such a way that the clamp should conform to IS: 5561/1970 or any latest revision thereof.

4. RATING:

The connector rating shall match with the rating of the respective equipment for the terminal connectors and the connectors for bus bar and dropper should be of the following rating. Minimum thickness at any part of connector shall be 10(ten) mm. Indicative ratings are given below:

- | | | |
|----|--|---------------------------|
| 1. | Terminal Connectors for Isolator(Amps) | as per rating of ISOLATOR |
| 2. | Terminal Connectors for CT | As per CT rating |
| 3. | Terminal Connectors for LA | As per LA rating |
| 4. | Terminal Connectors for PT | As per PT rating |

5. EQUIPMENT CONNECTORS:

Bimetallic connectors shall be used to connect conductors of dissimilar metal. The following bimetallic arrangement shall be preferred.

- i. Copper cladding of minimum 4 mm. thickness on the aluminium portion of connector coming in contact with the copper palm or stud of the equipment.
- ii. Alternatively, to provide cold rolled aluminium copper strip between the aluminium portion of the connection, the sheet thickness shall not be less than 2 mm.

Sufficient contact pressure should be maintained at the joint by the provision of the required number of bolts or other fixing arrangements, but the contact pressure should not be so great as to cause relaxation of the joint by cold flow, the joint should be such

that the pressure is maintained within this range under all conditions of service, to avoid excessive local pressure, the contact pressure should be evenly distributed by use of pressure plates, washers or suitable saddles of adequate area of thickness should be less than that of an equal length of conductor where measured individually test results showing the milli drop test and resistance should be enclosed with the bid.

All connectors shall be so designed and manufactured as to offer ease of installation as these are to be used in overhead installations, design shall be such that full tightening of nuts and bolts should be possible with the use of double wrench. The connectors shall be such as to avoid local corona, sound or visible discharge.

6. TEMPRATURE RISE

The temperature rise of connectors when carrying rated current shall not exceed 45° C above reference design temperature of 50° C.

- i. Acceptance Tests
 - a) Tensile Test
 - b) Temperature rise test
 - c) Temperature rise test
- ii. Routine Test
 - a) Visual Inspection
 - b) Dimensional Check

Type test reports from a recognized laboratory shall have to be submitted.

7. WEIGHTS

Weights of different materials uses in manufacture, such as aluminum, silicon, copper etc. should be clearly indicated in the bid.

8. INTERCHANGE ABILITY

Corresponding parts of similar clamps and connectors shall be made to gauge or jig and shall be interchangeable in every respect.

PART-32
ERECTION SPECIFICATION FOR
220KV CABLE

Erection Specification for 220kV Cable

Sl. No	CONTENT
1	Scope
2	Route Inspection
3	Preparation
4	Accessories
5	Cable Laying & Installation
6	Jointing And Termination Works
7	Preparatory Works For Cable Joint & Termination
8	Insurance
9	Jointing And Termination Works Schedule
10	Site Tests
11	Pre- Commissioning Tests
12	Documentation
13	Manuals
14	Schedule Of Drawings
15	List Of Consumables To Be Supplied By The BIDDER
16	Test Data On The 220kv XLPE Cable And Accessories Offered
17	Annexure-1 Trench Cross Section(Typical)
18	Annexure-2 Duct Arrangement For Road Crossing(Typical)
19	Annexure-3 Nala Crossing
20	Annexure-4 Joint Chamber Of 220kv Cables (Typical)
21	Annexure-5 Drain Crossing For 1.5m Depth-1
22	Annexure-6 Drain Crossing For 3 M Depth-1
23	Annexure-7 Nala Crossing-2
24	Annexure-8 Railway Crossing-1
25	Annexure-9 Diagrammatic Representation For Rock Cutting Or Boring
26	Annexure- 10 Diagrammatic Representation For Barricade

1. SCOPE:

This specification covers the erection of 220kV, 630Sq.mm single core, stranded compacted circular Copper conductor, XLPE insulated Lead sheathed cable (1X3 runs of single core cable for 2 Nos. 3 phase feeders and accessories including handling, laying, jointing, terminations, back filling, site testing and commissioning the complete Cable system in TFL SS, Talcher, India, covering the following:

Detailed route survey and preparation of Cable route profile drawing finalizing Joint locations and necessary soil Testing and evaluation of the soil resistivity, soil thermal resistivity of the soil along the cable route at every 200mts, and based on the data, recommend the final system design.

- a. Perform a through route soil thermal resistivity survey by in-site testing along the entire cable route.
- b. Conduct a detailed analysis of soils / strata encountered along the route for the thermal performance under specified cable loading.
- c. Specify a suitable thermal backfill so that the soil T.R. does not exceed 120⁰C cm/watt, to encapsulate the cables to prevent thermal run away of cable.
- d. Formulation of thermal backfill, quality control and supervision during backfill.

Transport, storage, preservation and conservation of cable, cable accessories, all equipment, materials, tools and plants etc., at site whenever and wherever necessary.

Follow up action to obtain necessary permission from the local authorities, police, railway authorities etc., for the cable trenching works etc.,

The associated civil works, which are necessary for laying / installation of power cable, though not specifically mentioned, but shall be completely in the scope of BIDDER as per approved drawing, indicative drawing for reference.

Scope of work shall also include laying of HDPE pipe and optical fibre cable in the pipe, Optical Fibre cable jointing etc.

During Erection or supply any loss to public property, departmental property for example sewage pipe, communication cable etc. should be compensated by the BIDDER, the responsibility for the same completely lies on BIDDER itself and no extra cost should be imposed/requested from the owner.

“A PERT chart indicating the time schedule for supply of cable and accessories and supervision of cable laying, testing and commissioning shall be furnished by the successful Agency in consultation with TFL’s erection Engineers and should be got approved along with the drum length approval. The schedule should be kept up by the successful Agency. Any delay in completing all the works attributable to the successful Agency will attract LD.

2. ROUTE INSPECTION:

The BIDDER shall have a detailed inspection of the route with TFL in order to finalise:

- a. The position of the Cable joint chambers and the position of the link box (es).
- b. The actual lengths of cable between the joint chambers.
- c. Manufacturing length shall be determined as per the joint route survey with TFL and acceptance by TFL. The drum length approval should be obtained within two months from the date of receipt of L.O.I. Manufacturing tolerance of 0.5% on each drum length subject to a maximum of +1% on the total approved length of the cable will be permitted. Each set of 3 drums intended for each section shall be of equal length subject to tolerance.

- d. The soil thermal resistivity of the route by conducting necessary tests, testing equipment shall be supplied by the successful Agency.

3. PREPARATION:

Before starting the site work, the following activities must have been completed and copies of relevant documents are available at the site of the works:

- a. Accurate plans showing all apparatus (PWD, Municipal Corporation's and other utilities or service providers) in vicinity of work site.
- b. Plan of proposed cable route.
- c. Statutory Notifications and clearance from various authorities/agencies as required for the work.
- d. Coordination drawings from the other service providing agencies indication the equipment/pipelines/cables etc. laid on the proposed route. Surface covers belonging to other utilities may give a guide to the location of their equipment.
- e. Unless it is known from co-ordination drawings that the route is relatively clear of obstructions, trial holes shall be taken at proposed joint locations and at such other positions along the route as is necessary to ascertain the practical positioning of the cable. Trial holes should generally be at right angles to the run of cables and at least 150mm deeper than the proposed trench.
- f. The successful Agency shall furnish all necessary information, including drawings, manuals and instructions relating to both cable laying and jointing practice.

4. ACCESSORIES:

All jointing and termination works shall be carried out by the successful Agency on turnkey basis with their own best supervision in the presence of TFL/OPTCL.

Dust and humidity free enclosures, complete with air conditioners and material handling equipment shall be used by the successful Agency.

All special tools including a set of jointer's hand-tools that are necessary to complete the joint/termination works shall be arranged by the successful Agency.

Necessary power supply for jointing and termination works shall be arranged by the successful Agency. The cost of consumables which are essential for satisfactory erection and commissioning shall be included. No extra cost will be paid towards the cost of consumables.

Adequate quantity of consumables shall be supplied for completing the entire cable laying and jointing works. The list of such consumables shall be furnished in the Schedule. Consumables or Mandatory spares shall be useful at least for 5 years after the supply.

5. CABLE LAYING & INSTALLATION:

The successful Agency must satisfy himself regarding the actual soil resistivity along the proposed cable route before laying cable.

The supplier shall carryout the necessary calculations and design works at no cost to the purchaser to finalize the respective cable system based on the survey results.

The cable drum must be handled correctly and with care during transport and laying of the power cables, in order to avoid damage to the cables and injury to people. Any damages done because of poor handling of the cables to the properties of corporation, private OR to anybody shall be responsibility of successful Agency and TFL reserves the right to recover the amount due to such damages.

Mechanical process/puller shall be adopted for pulling the cables. Manual pulling of cables shall be avoided and can be resorted in extreme cases subject to the approval of TFL.

While pulling the cable pulling tension should not damage the cable. Manufacturer's instructions in this regard shall be followed strictly. Puller shall be provided with suitable tension meter for monitoring the pulling tension.

Rollers at regular interval shall be provided during cable pulling to prevent damage to the cable. The roller shall be of nylon or equivalent material.

The minimum bending radius of the cable shall be maintained as per the manufacturer's recommendations.

RCC cable route markers and RCC joint markers shall be provided as required for buried cable trench. The voltage grade of cable shall be engraved on the marker. Location of underground cable joint shall be indicated with additional inscription "cable joint". The marker shall project 150mm above ground and shall be provided at every change in direction.

The successful Agency has to open site store at and ensure for safe custody of all the stored materials at his own cost.

The successful Agency should take the prior approval from TFL/OPTCL for all the drawings related to erection work before commencing the work at site for example: Laying procedure, jointing chamber, Road crossing, Nalla Crossing, barricading structure design etc. after approval from the TFL/OPTCL the contract can execute its work.

The detailed indicative procedure for cable laying is described with drawing.

The existing roads shall be cut up to the required extent for laying the EHV cables. The layers of sub base and WBM and their thickness shall be spread uniformly and rolled to position to match with the prior existing road layers through proper watering and compaction procedures. The resultant surface shall conform to the adjacent levels. Finished top of restored roads should match with the existing road level. Bituminous Sealants shall be used to fill the gaps between the restored part of the road with the existing level. The roads shall be restored to the extent of satisfaction of the competent authority. Road construction shall be as per IRC standards.

The route map showing the proposed installation of power cable will be issued to the successful Agency. The Bidder is advised to undertake site visit in order get acquaintance with the route.

Construction of cable ducts wherever necessary for road crossing, railway crossing etc., as per the approved drawing, indicative drawings for reference.

Construction of cable Bridge (if applicable) for river/ canal crossing as per the approved drawing, indicative drawings for reference.

Construction of duct for railway crossing (if applicable) by horizontal boring method as per the approved drawing.

successful Agency shall arrange space for working office, workshop & store/yard for storing requisite material like kits, cables etc.

Avail necessary insurance coverage for the storage transportation of cables, accessories and all relevant materials from stores to site and back to stores, cable jointing works, testing, commissioning including third party risks theft and fire, and all acts of God perils till the period of handing over to TFL/OPTCL.

Excavation of cable trench and construction of RCC joint pit, civil works for the termination support structures including supply of all materials etc., as per the approved drawing, drawing no.

Transportation of cable drums from Owner's stores to site for cable, laying and taking back empty cable drums/cable drum with cable bits back to stores. Transporting of all required tools and plants like generator, winch, rollers, motorized rollers, control cable etc., from pocket stores to site and back if necessary.

Preparation of the sand bed for cable laying as per the approved drawing, TFL.PK1.1.

Placing the cable drum stand in the proper position with the drum stands.

Placing of power operated winch in proper position and connecting with AC supply.

Cables are to be laid/buried underground and shall normally buried directly in dug up trenches in the ground as per all applicable standards and IS 1255.

The sealing of power cable ends during the storage; execution & completion of jointing works shall be in the scope of successful Agency. In no circumstances, the cable ends shall be kept open. It shall be responsibility of successful Agency to make them good OR replace free of cost without affecting the completion schedules. The amount due to damages done because of water/moisture ingress OR penetration in the cable/conductors during execution shall be recovered from the successful Agency.

Three single core cables shall be laid in trefoil /horizontal formation. Trefoil clamps as required are in the scope of the BIDDER.

Laying of the 220kV cable under proper supervision using motorized rollers and securing them at 5m interval in flat/trefoil formation.

After cable laying, supply and filling the trench with river bed sand or fly ash mixed with sand in the ratio of 10:1 after cable laying as per the approved drawing.

The power cable shall be laid generally at a depth of 1500mm and can vary, if obstacles like power cable of other rating/telephone cable/water pipe line etc, come in the way of installation. At least minimum Depth of 1500 mm shall be maintained from nearest road level

The cables shall be completely surrounded by a layer of having low thermal resistivity (selected sand) sand minimum about 250mm over &150mm below of the cable surface throughout width of the cable trench at no extra cost. (River sand shall be allowed for surrounding layer)

The extra protection of pre-cast flat RCC slab with proportion 1:2:4 having size 1000 (L) X 450 (B) X 50 (Thick) mm shall be provided about 250mm over the power cables for complete route of the cable. The RCC slab shall be with proportion not less than 1:2:4 (M-15) and also shall have steel reinforced of 8 mm dia. steel bar (4 nos. of 450mm side and 12 Nos. on 1000 mm side) at adequate required distance. The slab shall be given curing time of minimum 15 days.

The dug up trenches after laying the cable, sand filling and providing slab protection shall be back filled with the materials earlier excavated, however, bigger stones or piece of rock, or extra excavated material (if any) should be removed and properly dumped and if required new soil has to be provided and used for back filling with no extra cost. The back filling soil shall be properly compacted by using mechanical/hydraulic procedure.

Where it is not practicable to obtain normal burying depths, consideration should be given to laying the cables in ducts, which in turn may have to be protected by concrete and/or steel plates. Alternatively, chases may be formed under the footpath and suitably protected from the possibility of vehicles mounting the footpath.

Supply and filling the PVC pipes at all roads with bentonite mixtures. Also supply and placing of rubber sheets at the mouths of the PVC pipes for protecting the cable.

Supply and placing the protective RCC slab after cable laying and stencilling the feeder name over the same, supply and providing PVC warning tapes over the RCC slab, and removing and replacing the above in the joint bays after jointing.

Conducting the sheath test after cable laying in each section in the presence of TFL and PMC Engineer, authority.

Rectification of sheath fault if any and retesting in the presence of TFL Engineer.

Closing the trench after cable laying as per the approved drawing and removal of surplus

earth from the site along the cable trench.

Supply and providing suitable trefoil clamps and applying fire retardant paint wherever the cable remains exposed.

The successful Agency shall arrange for the qualified and competent supervising Engineer/Engineers and necessary minimum number of jointers, semi-skilled labourers, as he deems it absolutely necessary.

Provision of special tools /Plants / appliances required for conductor jointing and stripping / dressing and application of XLPE insulation etc. shall be made by the successful Agency. Supervision and Erection of joints and terminations including erection of link boxes with all preparatory works

Adopting all safety measure as per the orders of local authority in vogue, safety procedure as mentioned in tender document.

Preparation of drawings etc., for obtaining Telecom clearance and applying through TFL.

Obtaining clearance for energization from Telecom dept.

The successful Agency has to keep 220 KV power cable, material supplied by them in safe custody and transport to the respective sites and will be fully responsible for any damage or loss of any or all allotted equipment or materials supplied by them at any stage during transportation or erection till taking over by the TFL. **The successful Agency has to return empty cable drum as instructed by TFL.**

BIDDER has to consider arrangement at its own cost for first-aid, fire protection, electricity and water requirement at site.

BIDDER shall also arrange for sign board, caution board, Barricade panels to restrict unauthorised entry to work area, safety & security personnel etc. on cable route.

Clearance between any utilities and cable shall be maintained as per Standards at any point.

6. JOINTING AND TERMINATION WORKS :

The Jointing shall be with pre-moulded outdoor type joints, it shall be carried out under strict supervision of the specialist approved by the manufacturer and as per the manufacturer's instruction. The sheath/screen bonding system shall provide a continuous current path through the cable sheath and jointing kits and shall be bonded. The bonding ends shall be suitably earthed as per approved configuration/design. The sheath voltage under full load condition shall not exceed the voltage specified/allowed in relevant standard for safety of personal as well as satisfactory working of cable. Sheath shall be solidly grounded at suitable location. Successful Agency must indicate details of configuration proposed along with sufficient calculation with the bid so as to limit induced voltage of sheath within 65V. Cable shall be terminated at Outdoor Cable Sealing end on both side mounted on suitable steel structure to enable connecting to the transmission line.

The erection of joints, sheath separation kits and terminations shall be done by the successful Agency. The details are to be furnished.

For jointing and terminations, one qualified Engineer and required trained EHV jointers with supporting staff should be deputed. The Engineer and EHV jointers shall possess valid certificate from the manufacturer of the Accessories, for erection.

The joint bays shall be as per approved drawing which may vary according to the site conditions.

Power supply at the jointing bays and at the termination site, shall be arranged by successful Agency.

The preparatory works as per Clause 3 of this section, for jointing and termination works

shall be done by the BIDDER.

It is the sole responsibility of the successful Agency to check for any accidental damages in the cable while re-excavation, during jointing and termination works. It will be the responsibility of the successful Agency R to rectify the damaged cable to make good with any additional joints free of cost or relocating the joint position.

7. PREPARATORY WORKS FOR CABLE JOINT & TERMINATION:

SCOPE OF WORK FOR JOINTING:

1. Uncoiling, cleaning, straightening and trimming of 220KV Cable as required for jointing.
2. Checking the cable inside the joint bay before cutting the cable, for any accidental damages due to re-excavation.
3. Providing the joint tent, tools, etc at the site.
4. Erection of joint tent (joint tents should be of metallic housing)
5. Electrification of the joint bay, arranging and fixing of air conditioners and maintaining them for the entire period of jointing. (Temperature inside the joint tents should be maintained below 25 Degree C).
6. Transporting the required quantity of jointing kits from stores to site (including link boxes).
7. Dismantling the wiring, Air conditioner, etc.
8. Dismantling the joint tent.
9. Devolution of cable cut bits to departmental stores including transport
10. Providing security guards for joint bays.
11. Cost of power for the entire period of jointing has to be borne by the BIDDER.
12. Providing 2 Nos., 2 HP Diesel Dewatering pumps
13. Providing of sheath separation kit for earthing wherever necessary.
14. Related works if any, in conjunction with the jointing and termination as stipulated by the TFL engineer has to be carried out.
15. Earthing of termination structures with new earth pits as stipulated by the TFL engineer.

DETAILS OF CIVIL WORKS INVOLVED IN JOINTING:

1. Excavation of joint pit and cable trench required for jointing.
2. Removal of RCC slab for the joint bay/trench.
3. Refilling the joint bay with fresh lake bed sand.
4. Covering the joint bay with RCC slabs
5. Refilling and consolidation with excavated earth over the top of RCC slab and carting away the surplus earth.
6. Other related works.

TERMINATION:

1. Erection of termination structure.
2. Removal of cable from the trench, re-routing, cleaning, straightening and trimming, if necessary, check the exposed cable before cutting the cable, for any accidental damages due to re-excavation.
3. Providing of scaffolding pipes, clamps, wooden plank and tools for erection of termination.
4. Erection of scaffolding pipe/providing crane for lifting the 220 KV Cable end termination.
5. Lifting the cable up the terminal structure and positioning

6. Transporting the termination kit from departmental stores (including link boxes)
7. Complete the termination.
8. Dismantling scaffolding work.
9. Transporting the above item back.
10. Devolution of cable cut bit to the departmental stores including transport.
11. Provision of Security Guard for the cable end / terminations
12. Providing kick guard and spring loaded clamps
13. Providing fire retardant paint for exposed portion of the cable and other related works.
14. Power supply for the entire period of work by BIDDER.

DETAILS OF CIVIL WORKS INVOLVED IN TERMINATION:

1. Providing foundation for termination structure as per approved drawing.
2. Excavation of trench for releasing the covered cable portion near terminal structure
3. Removal of RCC Slabs covering the cable.
4. Covering the cable with lake bed sand supplied by Board after completion.
5. Placement of RCC Slabs.
6. Refilling the trench and consolidation with excavated earth over the top of RCC slab and carting away the surplus earth.
7. Other related works.

The erection of joints and termination are to be supervised by a competent Engineer of the contract or in the presence OPTCL/TFL engineer.

Erection and supervision of required sheath bonding cable, wires, earth electrodes and bare copper for sheath bonding as to be done at cross bonding locations. Earthing of termination structures and forming earth mat with existing earthing arrangement including materials for earthing arrangements and all civil works are to be executed by the successful Agency.

Note: All materials such as cement, RTS rods, flats, planks, steel, and PVC pipes etc., required for civil works shall be arranged by the successful Agency.

BONDING OF CABLE:

The successful Agency shall submit the sheath induced voltage calculations for the proposed length of the cable. Also the methodology for most economical and technical sound bonding connections shall be proposed. The bonding connection designed should limit the sheath circulating current and sheath induced voltage to the tolerable level. The sheath induced voltage under normal operating conditions shall not exceed 65Volts to ground at any point.

The proposed bonding shall be executed after obtaining approval from the client.

At the termination end, bonding shall be adopted by solidly earthing the cable sheath through the single phase disconnecting link boxes. Cross bonding can be done with three phase link boxes with CCPUs at the specified locations based on the sheath voltage calculations. The specification for the link boxes, link box housing, CCPU and the sheath bonding cable is given hereunder.

LINK BOX FOR EARTHING:

The link box for earthing wherever required shall have provisions with earth links, so as to isolate the sections and check the integrity of sheath of each section independently. The terminals connecting, disconnecting links and the earthing link shall be made of tinned copper.

The bolts and nuts shall be of stainless steel. The 'O' ring shall be of Chloroprene/Neoprene rubber. The insulator supporting the links shall be of epoxy resin. The case and lid shall be either hot-zinc sprayed or painted with epoxy paint.

The drawings of the link boxes and link box housing have to be approved by the purchaser before supply of the same.

The 3 phase link box used for sheath separation shall be housed in a compact metallic housing unit and it should be free from water entry.

CCPU:

In order to protect the joints and terminations from normal surge voltage induced in cable sheath circuit, Cable covering protection unit (Surge voltage limiters) shall be provided. The gasket shall be of suitable material so that entire CCPU is completely weather proof. The CCPU shall satisfy the following conditions:

Insulation resistance between terminals shall be not less than $2M\Omega$ at 1000V DC. Energy absorption capacity is 8 KJ.

SHEATH BONDING CABLE:

The sheath bonding Cable shall consist of compact, circular, Flexible Plain annealed copper conductor, heavy duty PVC insulated and black heavy duty PVC Outer sheath. The outer sheath should be provided with conductive layer on the outer surface.

Insulation shall be extruded by single head extrusion process, with absence of voids, contaminants and moisture content.

The conductor shall be of Flexible plain annealed copper wires conforming IEC.60228 (class-6). The shape of conductor shall be compact circular.

EARTHING AT INSULATED JOINTS:

The earthing at the sheath separation joints/Insulated joints has to be executed by the supplier as follows:

At the cross bonding joint bay additional joint pit in length shall be excavated approximately for a length of 4m at the same depth.

Copper spikes of length 1.5m have to be driven at the corners of the joint bay up to 1.2m into the ground. Bare copper (240 sq.mm) conductor of length 12m shall be laid around the corners of the pit thereby inter connecting all the copper spikes.

The bonding cable from the insulated joint shall be laid from the joint pit and terminated inside the link box. Copper lugs have to be used to terminate the bonding cable. The bonding cable shall be secured to avoid damage by the external agency. PVC pipes can be used in this regard.

The sheath bonding cable laid for earthing the link box shall be connected to the bare copper conductor. Copper clamps shall be used to terminate the copper conductor and the bonding cable firmly to the spike.

Plinth of at least 30cm height shall be constructed with brick work above which the bottom of the link box housing can be placed to avoid entry of water at road ends. The link box housing shall be painted with single coat of red oxide paint and two coats of grey enamel paint. "Danger, 220KV Cable Link box" plastic board has to be provided over the link box

housing. Separate feeder name plastic board has to be provided.

EXCAVATION AND WASTE:

- a) Trench width shall be decided considering the number of cables to be laid, configuration in which these are to be laid (Horizontal/trefoil) and the spacing between the cables.
- b) Trench excavation shall be undertaken mechanically as far as possible. Manual excavation shall be minimal.
- c) The trenches should have lines, levels, and contours to suit continuous pulling of cable by mechanical puller.
- d) Be as straight as possible. Where bends are unavoidable the trench should allow the cable to be installed at not less than its minimum-bending radius using cable rollers.
- e) Be to the approved dimensions and normally have vertical sides which should have a side support system (e.g. shuttering), should the ground be soft or loose.
- f) Have a firm and smooth contoured base.
- g) Be excavated with such precautions as are necessary to prevent damage to the highway or ground surface from a slip or breaking away of the sides of the trench. Cutting by machine (e.g. road saw, chain excavator or planer) is preferred.
- h) Back filling with excavated earth / soil rolling to be done at 150mm thick layers, laying GSB layer for 50mm thick total up to the existing road level, spraying water & power rolling on the same.
- i) Be excavated so that all railways, tramways, walls, roads, sewers, drains, pipes, cables, structures, places, shall be secure against risk of subsidence or damage, and shall be carried out to meet the requirements of the authorities concerned.
- j) Where they pass from a footway to a roadway or at other positions where a change of level is necessary, have a base that rises or falls gradually.
- k) Be cleared of water by pumping to prevent the risk of the trench collapsing and hazard to the general public, especially trespassing children. In locations where flooding can occur, measures shall be taken to divert rainwater away from the trench (e.g. use of sandbags).
- l) Have provisions made during their excavation to cater for access of persons and vehicles to property of places alongside the route.
- m) Other works and properties, such as decorative walls and lawns, shall be safeguarded against damage from excavated material by using some form of sheeting. When machines are being used for excavation and the location of other plant is known, the plant should be uncovered by hand excavation to reduce the possibility of damage. If the excavation is likely to reduce the stability of any part of any structure, work shall not be commenced unless adequate precautions are taken to prevent the structure from collapse or deterioration. Flooding or vibration from heavy traffic can cause collapse of trench sides and subsidence of adjacent structures. A trench side support system or shoring shall be used to avoid this.
- n) Special care should be taken not to damage the cable during consolidation and only hand rammers should be used as far as possible.

ROUTE CROSSINGS:

- a) Where road crossing comes in way of laying power cable, the power shall be laid through NP-4 RCC Hume Pipes. The required length of Hume pipe shall be in the scope of the BIDDER. Where pipes and ducts are to be installed they should be kept as straight as possible and should be surrounded by crushed limestone dust. The filling

medium shall be prepared by adding 20 parts of sand and 8 parts of cements, by weight, to 100 parts of a 10:1 water/bentonite mixture.

- b) Ducts, which are filled with a bentonite mixture, shall be installed wherever possible in a concrete surround but if not, any joints in the duct run must be effectively sealed. At the duct ends, the gap around the cable must be effectively sealed to prevent migration of the bentonite mixture and preserve its moisture content under service conditions.
- c) During the crossing of utilities like water line, drainage lines, telephone lines, gas lines etc. sufficient care shall be taken & protection shall be made available so that other utilities do not damage the cable mechanically and/or electrically or do not affect the performance of the cable.
- d) **NALA CROSSINGS/CULVERT CROSSINGS:** The Nala crossings are to be made with separate fly-over bridges of adequate sizes to carry all the cables in required formation. The bridges are to be made at the sufficient distances from the edge of Nala considering the further expansions of roads. The strength shall be such that it should not wash away with the flow of water during heavy rain. All cables shall be snaked prior to the approach of an abutment, to allow for expansion and contraction of the bridge structure.
- e) **ROAD CROSSINGS:** It is highly unlikely that any surface excavation will be allowed on roads after they have been opened to traffic. Underground crossings may only be allowed if guided boring techniques are employed. It is therefore extremely important that provision be made during the construction of roads for cable crossings.

CABLE DRUMS - HANDLING AND POSITIONING:

When handling drums, suitable precautions should be taken to avoid damage to the cable and injury to people. Due regard should be paid to the mass of the drum, the method and direction of rolling and the method of lifting. When rolling drums, it should be over short distances only and the drum rotation should always be according to the arrow marked on the drum flange. Precaution may be taken to avoid slack cable collecting at the hub of the drum causing damage. Normally, the cable will be pulled direct from the drum trailer but in its absence, drum jacks and greased spindles should be used for smooth rotation of drum. Cable drum jacks should be mounted on a firm level base. If the ground is uneven, a foundation should be provided by using stout timber solidly packed. If the drum is to be placed away from the trench, the drum should then be offset by not more than 30 degrees to the line of the trench. The drum mounting position, if stationary, will be influenced by the following:

- a) **Accessibility** - Good access to where the cable drum is to be mounted.
- b) **Gradient** - On sloping ground, cables should be pulled downhill.
- c) **Bends** - The drum should be mounted at the end of the trench nearest the bends. The force required to pull cable is less near to the drum, and therefore, the side forces and friction on the bends will also be less.
- d) **Ducts** - To minimise the disturbance to ducts and the resulting possibility of damage to the cables, the drum should be at the end of the trench farthest from the ducts.
- e) **Jointing** - Consecutive lengths of cable should be laid 'A' end to 'Z' end to ensure correct rotation of the cores when jointing..

WINCH POSITIONING:

The winch should be positioned at the end of the cable trench and securely anchored.

CABLE BEDDING:

The bed of the cable trench shall be free from water, stones, and pieces of rock that may cause damage to the cable. Loose stones in the trench sides that may be dislodged during the cable pull, shall be removed. Crushed limestone dust 3mm to dust, or crushed stone dust, should be laid to provide suitable bedding for the cable or duct. Once the cable or duct has been laid onto the bedding a further layer of crushed limestone dust or crushed stone dust shall be applied, this shall be for a depth of 75mm above the cable or duct.

CABLE ROLLERS – POSITIONING:

The rollers are necessary to avoid abrasion of the cable by keeping it clear of the ground and to reduce friction during pulling. As required leading roller, straight roller, corner rollers shall be used. These rollers should be suitable for either winch or hand pulling. The arrangement of cable rollers will depend upon which of these methods is used. The straight rollers should be no more than 2m apart. A rope should be used to check that the corner assemblies have a smooth curvature, are free of protrusions and will allow the cable to rise smoothly on to the main area without bearing on the leading edge.

WINCH PULLING:

Dynamometers should be fitted to all winches so as the maximum pulling tension of the cables is not exceeded on installation. A digital print out should also be obtained at the end of each completed cable pull to prove the cable was not over tensioned during installation. It shall be ensured that cable pulling tension is minimized as much as possible. For safety, the lubricant may be applied by stick or brush and not by hand. Grease should not be used as the lubricant for rollers as grit will adhere to it. A mixture of common household powdered detergent and powdered graphite mixed in equal proportions with water to form a paste is recommended for this, as it is 'non-sticky' and loose stones are unlikely to adhere to the cable.

ATTACHMENT OF CABLE STOCKING TO CABLE:

Cable stocking of suitable size as per manufacturer's recommendations, shall be used for the attachment of the cable pulling rope to the cable. Care must be taken to ensure that the stocking fits over the over sheath of the cable. The cable stocking will also have a rating to the maximum pulling tension of the cable.

CABLE END CAPPING:

The capping of cable ends, once the cable has been laid, is very important to prevent the ingress of moisture by using either

- (a) Cold shrink cap
- (b) Heat shrink cap
- (c) Denso Tape seal (only as temporary measure)

IDENTIFICATION, MARKING AND WARNING:

- a) The identification marker shall be of adequate size fabricated from 3mm thick, 25mmx25mm lead for underground cable. The marker shall be embossed with letter as stated below: "TFL -220 kV Ckt-I /II" and "Phase R or Y or B" as the case may be The

marker shall be tightened with nylon thread along with each cable at interval of 3 meters in such a way that it does not damage/penetrate the outer sheath of cable because of the dead weight of back filled materials OR soil.

- b) A pre-warning PVC yellow tape with size 152 mm (width) x 100 microns thick (HDDPE)/LLDPF shall also be laid as per following clause of the specification. The warning tape shall also contain the “WARNING” printed in black letters as (In English as well as Telugu) “CAUTION: 220000 VOLTS TFL CABLE”
- c) A pre-warning tap as per above clause shall be laid below ground level in the earth about 400/500 mm deep along the route of cable and in jointing bays
- d) The cable route marker is to be made from R.C.C. blocks duly embossed on all the side as “TFL 220KV CABLE LINE” The minimum size shall be 600x400x50 mm. It shall be at least embedded in ground up to 400mm depth. The exposed portions shall be painted in Red colour with non-washable paints. The interval should be minimum 30meters between two markers. It should be put at bends, curves, road crossing etc. of cable route.

8. INSURANCE:

STORAGE INSURANCE:

The BIDDER should provide necessary insurance for the materials stored at the department stores supplied under this contract till the period of completion of the work against, any loss, accidental damage or damage due to fire during the period of storage.

Such policy shall cover the property of the OWNER only and shall not cover any property of the BIDDER or any SUB-BIDDER, or his employees. The successful Agency shall submit the policy receipts for the premium to the OWNER / ENGINEER on the day of unloading the materials at stores. The premium paid for such insurance will be reimbursed in full by TFL provided the coverage period is the erection schedule period as it may also be noted that any extension of period of coverage for the insurance necessitated due to the delay in execution of the work solely attributable to the BIDDER, shall be borne by the BIDDER. It will be the responsibility of the supplier to replace the lost or damaged materials during storage, immediately to make good shortages and other losses free of cost and lodge and recover claim from insurance company.

Inland transit (all-risk) Insurance:

An insurance to cover the probable risks towards the cables, accessories etc., during transport from stores to site and back to stores, during storage at site has to be availed by the successful Agency in the name of TFL to ensure and safeguard the interest of TFL from the first day of the work till the completion, commissioning and handling over the project. The insurance coverage proposed to be availed may be got approved by the owner/ Engineer so as to ensure that all the interest of TFL including third party liability is covered. The premium paid for such insurance will be reimbursed in full by TFL provided the coverage period is the erection schedule it may also be noted that any extension of period of coverage for the insurance necessitated due to the delay in execution of the work solely attributable to the BIDDER shall be borne by the BIDDER. It will be the responsibility of the supplier to replace the lost or damaged materials during transit within 30days to make good the shortages and other losses free of cost, lodge and recover claim from insurance company.

Erection, testing and commissioning Insurance:

Contracting firm shall arrange to take necessary insurance coverage through any of the Insurance companies in India at their cost, towards all risks arising during erection, testing

and commissioning of cables, accessories and all relevant materials, cable jointing works, testing and commissioning including third party risks and all acts of God peril till the period of handing over to TFL. It will be the responsibility of the successful Agency to replace the defective /damaged materials, caused due to the various circumstances etc., within 30 days to make good the shortages and also to carry out all allied works to make good the loss / damage free of cost and to prefer the claim in time and get the amount reimbursed from insurance company with due intimation to the owner. The policy is to be taken initially prior to the movement of cable etc., from stores to site and as directed by the Engineer at site.

9. JOINTING AND TERMINATION WORKS SCHEDULE:

A schedule of activity indicating the jointing and termination works, testing and commissioning shall be furnished and got approved, by the successful Agency in consultation with the TFL's erection Engineers. The schedule should be kept up by the successful Agency. Any delay in testing and commissioning attributable to the successful Agency will attract LD at the same rate for supply of materials as per mentioned in general conditions of contract.

10. SITE TESTS:

Test on the installed cable system shall be carried out as per clause 14 of IEC-62067.

Test on the over sheath shall be carried out as per IEC-60229.

The test should be repeated when all the accessories have been installed, before commissioning.

TEST AFTER INSTALLATION: Pre-commissioning tests on site, to be undertaken by the successful Agency shall include the following:

- a) Insulation Resistance of each cable drum length after laying and before jointing.
- b) Tests for detection of damage to outer sheath, if any.
- c) Serving insulation resistance after laying each cable length shall withstand a voltage of 10 KV DC for one minute between each reinforcement and external conducting surface; In addition, the serving insulation resistance shall be measured and checked with the values obtained during routine factory tests.
- d) On completion of the cable laying and jointing work, the complete installation shall be checked with a D.C. voltage of 3 U₀ applied for 15 minutes between each conductor and sheath.
- e) Conductor resistance of each cable of each complete circuit.
- f) Test for 5 min. with system voltage applied between the conductor and the screen.
- g) Test for 24 hours with normal operating voltage of the system
- h) Continuity & phase confirmation.
- i) The pre-commissioning test at (f) or (g) at site may be undertaken as an alternative to the test (d).

The above tests shall be carried out by the successful Agency in the presence of OPTCL/TFL's representative.

Should a breakdown of the sheath occur during these tests, the successful Agency shall locate the fault and repair the cable(s) after TFL's agreement, until the retests give satisfactory results for the total link.

All expenses in connection with the civil works which are made necessary for faults(s) location and repair shall be borne by the successful Agency including additional costs for

the services rendered by the TFL.

11. PRE- COMMISSIONING TESTS:

On completion of cable laying, jointing and termination works, the complete installation will be tested with:-

- a. Dielectric test on over sheath as above for complete installation.
- b. A power frequency voltage equal to $1.7 U_0$ or 180 KV applied for 1 Hr between each conductor and metallic sheath as per CIGRE Group 21 studies, where U_0 is the r.m.s rated voltage at power frequency, between the conductor and the earth or the metallic sheath. Sheath fault occurring during laying, testing after laying and during pre commissioning should be rectified by the successful Agency free of cost (including civil works). Necessary sheath repairing kits with heat shrinkable materials are to be supplied as per the site requirement during execution of works.

The following Pre-commissioning tests shall be carried out by the successful Agency after installation:

1. Electrostatic Capacitance of the cable.
2. Resistance of the cable conductor.
3. Resistance of the sheath.

The BIDDER is requested to quote testing charges if any, or state whether the above tests will be carried out free of charge. It may also be noted that testing charges if any quoted, will also be taken into consideration for tender evaluation purposes.

The successful Agency should furnish (Three copies) of the test results for calculating the total losses,

The commissioning period shall be one month of operation. For this period of one month the cable circuits will be operated by OPTCL/TFL under normal conditions.

If a breakdown occurs on the cables or accessories during this period, all repairs shall be made by the successful Agency at his own expenses including civil works and road cut restoration charges. TFL reserves the right to request to change the full length of cable between the two joints chambers, free of charge including duties and taxes etc. This shall not apply for injuries of external origin.

After the verification is done, field tests shall be carried out again according to Clause-5 above.

The commissioning period shall be 3 months of operation after repairs and re-energisation. No breakdown shall occur. When the commissioning period is completed, the guarantee period will start.

12. DOCUMENTATION:

DOCUMENTS TO BE FURNISHED ALONG WITH THE TENDER:

- a) Description of the extrusion, curing and cooling processes.
- b) Cross section of the cable(s) with dimensions and weight.
- c) Electrical characteristic (conductor resistance, capacitance, electrical stress, etc.) of the cables.
- d) Detailed drawings of straight-through joints.
- e) Detailed drawings of sheath sectionalising joints for earthing enroute.
- f) Detailed drawings of outdoor sealing ends.
- g) Detailed drawings of indoor sealing ends.

- h) Detailed drawings of link boxes for sheath earthing.
- i) Arrangement of joint chamber with dimensions.
- j) Manning schedule for one set of 3 joints and one set of 3 sheath separation joints and one set of 3 sealing ends.
- k) Schematic diagram of the cable system.
- l) Arrangement of the terminal structures for outdoor sealing ends.
- m) Characteristics of the sheath voltage limiters and surge arresters.
- n) Detailed drawing of the steel cable drum.
- o) Transport, storage and handling practices for the cable and accessories.
- p) Design calculations.
- q) Type tests certificates issued by a Recognised Institution.
 - Detailed drawing of cable earthing arrangement.
 - Temperature vs. Current characteristics of the cable.
 - Power factor vs. temperature characteristics of the cable.
 - Power factor vs. voltage characteristics of the cable.
 - Partial discharge magnitude vs. voltage characteristics of the cable.

Factory Test on the 220kVXLPE cables and Accessories:

Impulse test (Hot Conditions):

- a. Number of samples tested and number of impulses for each of them
- b. Cable cross section and insulation wall thickness
- c. Type of joints
- d. Type of terminations
- e. Basic impulse level (wave form, peak voltage).
- f. Break down level

Power frequency test (Cold/Hot Conditions):

- a. Number of samples tested and voltage applied for each of them.
- b. Cable cross section and insulation wall thickness
- c. Type of joints
- d. Type of terminations
- e. Voltage applied and duration
- f. breakdown level

Long Term Test:

- a. Number of tests and for each of them.
- b. Length of the cable loop.
- c. Cable cross section and insulation wall thickness
- d. Number and types of terminations and joints.
- e. Installation conditions (air, buried).
- f. Voltage applied and duration.
- g. Heating cycles: duration and number of cycles.
- h. Conductor temperature at the end of a heating cycle.
- i. Break down conditions if any.

The above details shall be furnished as indicated in the Schedule under Specification

Clause No.12.

In operation experience:

The BIDDER shall fill in the details required in the Schedule for all the 220kV and above XLPE cable links in operation.

Documents to be furnished during the execution of the contract:

The successful Agency shall submit the following, not later than 3months after signing the contract, for TFL's agreement:

- a. Final sheath voltage calculations.
- b. Detailed drawings of the earth bonding at the terminal points and at the joint chambers at earthing locations enroute.
- c. Sheath voltage characteristics of CCPU.
- d. Installation procedures.
- e. Civil drawings pertaining to design of cable bridge, railway crossings, cover slab, offset slab for the cable route and joint with details of fabrication
- f. Detailed drawing for the weather proof GI pillar Box for housing Link 'Boxes, enroute, together with foundation.

13. MANUALS:

The successful Agency shall supply three copies of the following before commencing the cable laying works.

- a. Jointing procedures.
- b. Terminating procedures (indoor and outdoor).
- c. Fault location procedures (sheath and insulation).
- d. Procedures for measuring the soil thermal resistivity.
- e. Maintenance procedures
- f. Final route drawing.

The successful Agency shall supply a final record of all the tests not later than one month after commissioning.

14. SCHEDULE OF DRAWINGS:

(To be submitted by the successful Agency for approval)

1. Cable route with location of joint bays.
2. Design and drawing for cable bridge across river crossings.
3. Design and drawing for RCC cover slab.
4. Drawing for PVC warning tapes to be provided over RCC cover slabs.
5. Design and drawing of the foundation of GI pillar box to mount three phase link box.
6. Design and drawing of foundation for cable end outdoor termination structure with spring loaded clamps.
7. Design and drawing of earthing arrangement with earth mat for outdoor terminations.
8. Drawing for method of attending sheath faults.
9. Drawing explaining mounting of three phase link boxes.
10. Design and drawing for cable route / joint indication slab.
11. Drawing for trefoil clamp.
12. Drawing of terminal clamp for outdoor termination.

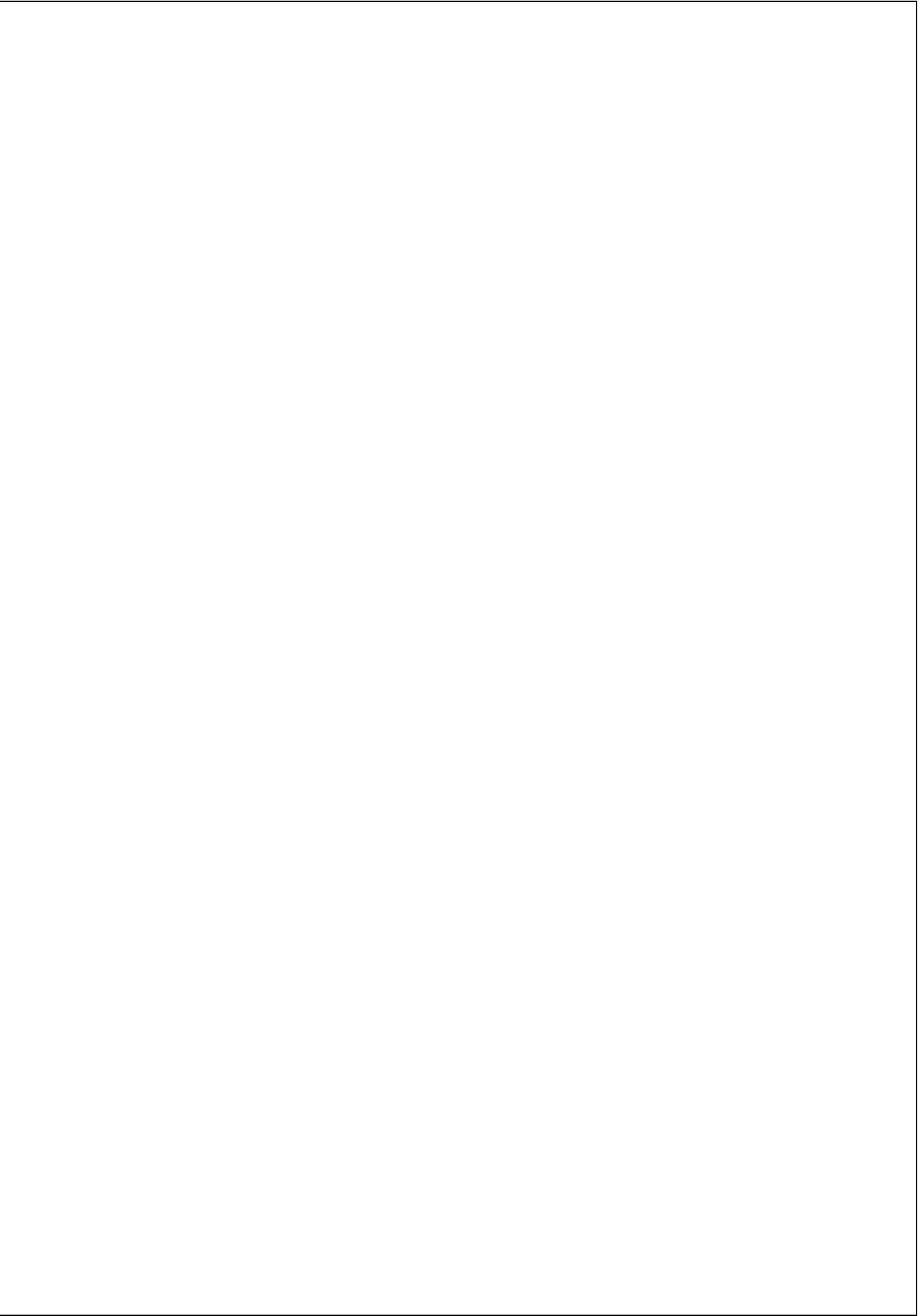
15. LIST OF CONSUMABLES TO BE SUPPLIED BY THE BIDDER:

SL. NO.	DESCRIPTION	QUANTITY

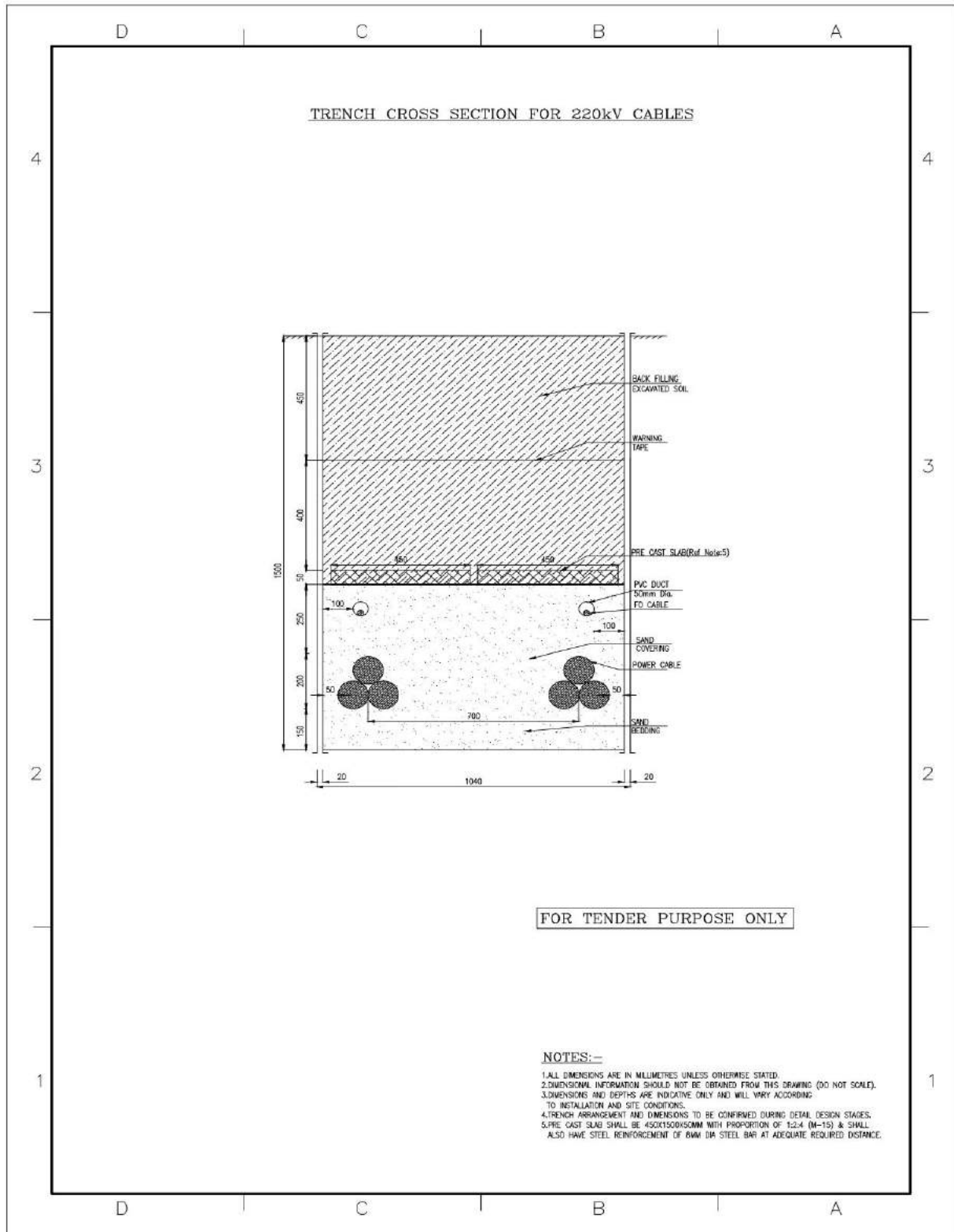
16. TEST DATA ON THE 220KV XLPE CABLE AND ACCESSORIES OFFERED

SL. NO.	DETAILSREQUIRED	TESTING STANDARDS	DATA/TEST RESULTS TO BE FURNISHED
1.	FOR IMPULSE TEST(HOT CONDITIONS):		
i.	Number of samples tested		
ii.	Cable cross section and insulation wall thickness		
iii.	Type of terminations		
iv.	Type of joints		
v.	Basic impulse level(wave form and peak voltage)		
vi.	Break down level		
2.	FOR POWER FREQUENCY TEST (COLD/HOT CONDITIONS)		
i.	Number of samples tested		
ii.	Cable cross section and insulation wall thickness		
iii.	Type of terminations		
iv.	Type of joints		
v.	Voltage applied and duration		
vi.	Break down level		
3.	FOR LONG TERM TESTS:		
i.	Length of the cable loop		
ii.	Cable cross section and insulation wall thickness		
iii.	Number and type of terminations and joints		
iv.	Installation conditions(air, buried)		
v.	Voltage applied and duration		
vi.	Number of heating cycles and duration		
vii.	Conductor temperature at the end of heating cycle		
viii.	Break down conditions (if any)		

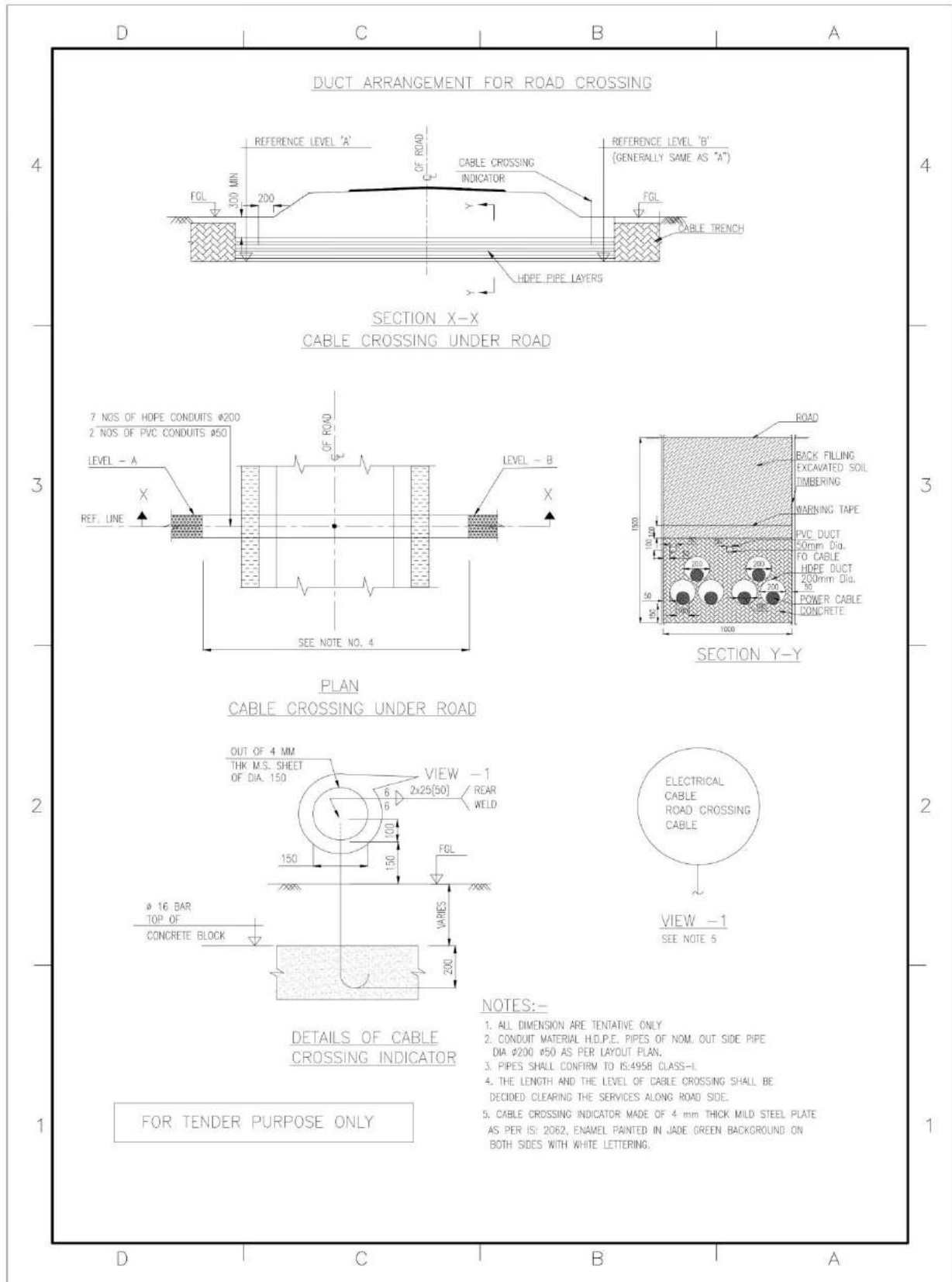
NOTE: Details should be furnished for each and every sample for item(1)and (2) and for each and every long term test for item (3).



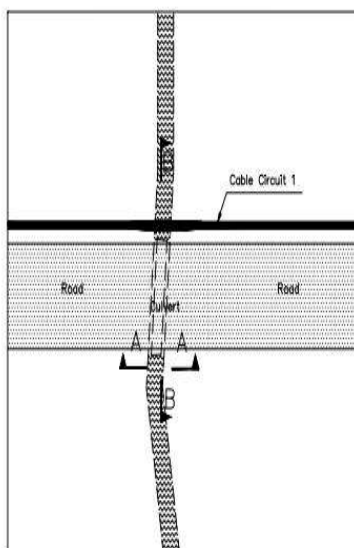
ANNEXURE-1
TRENCH CROSS SECTION(TYPICAL)



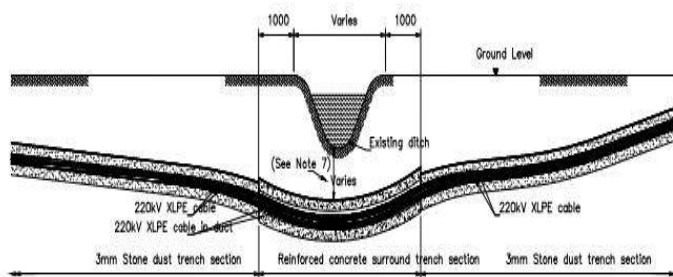
ANNEXURE-2
DUCT ARRANGEMENT FOR ROAD CROSSING (TYPICAL)



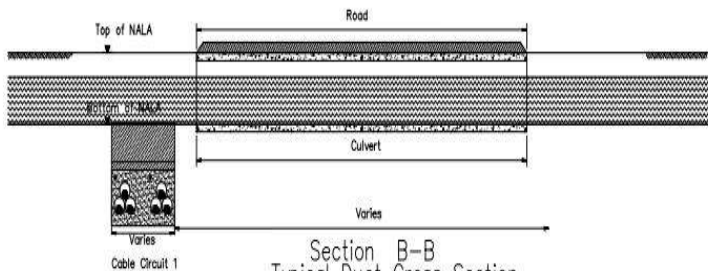
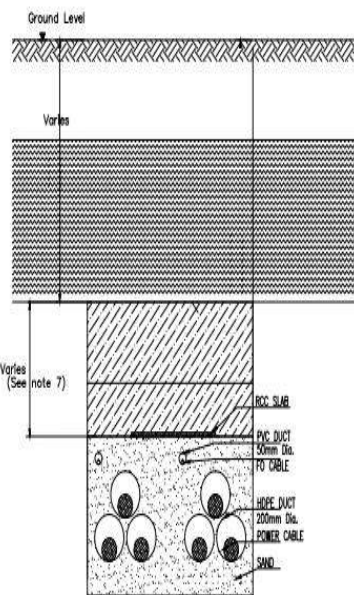
ANNEXURE-3
NALA CROSSING



Typical Plan View of NALA Crossing
1:200



Section A-A
Typical Section View of NALA Crossing (Cable)
(Service ducts and reinforcement omitted for clarity)
1:50



Section B-B
Typical Duct Cross Section
(Reinforcement omitted for clarity)
1:50

FOR TENDER PURPOSE ONLY

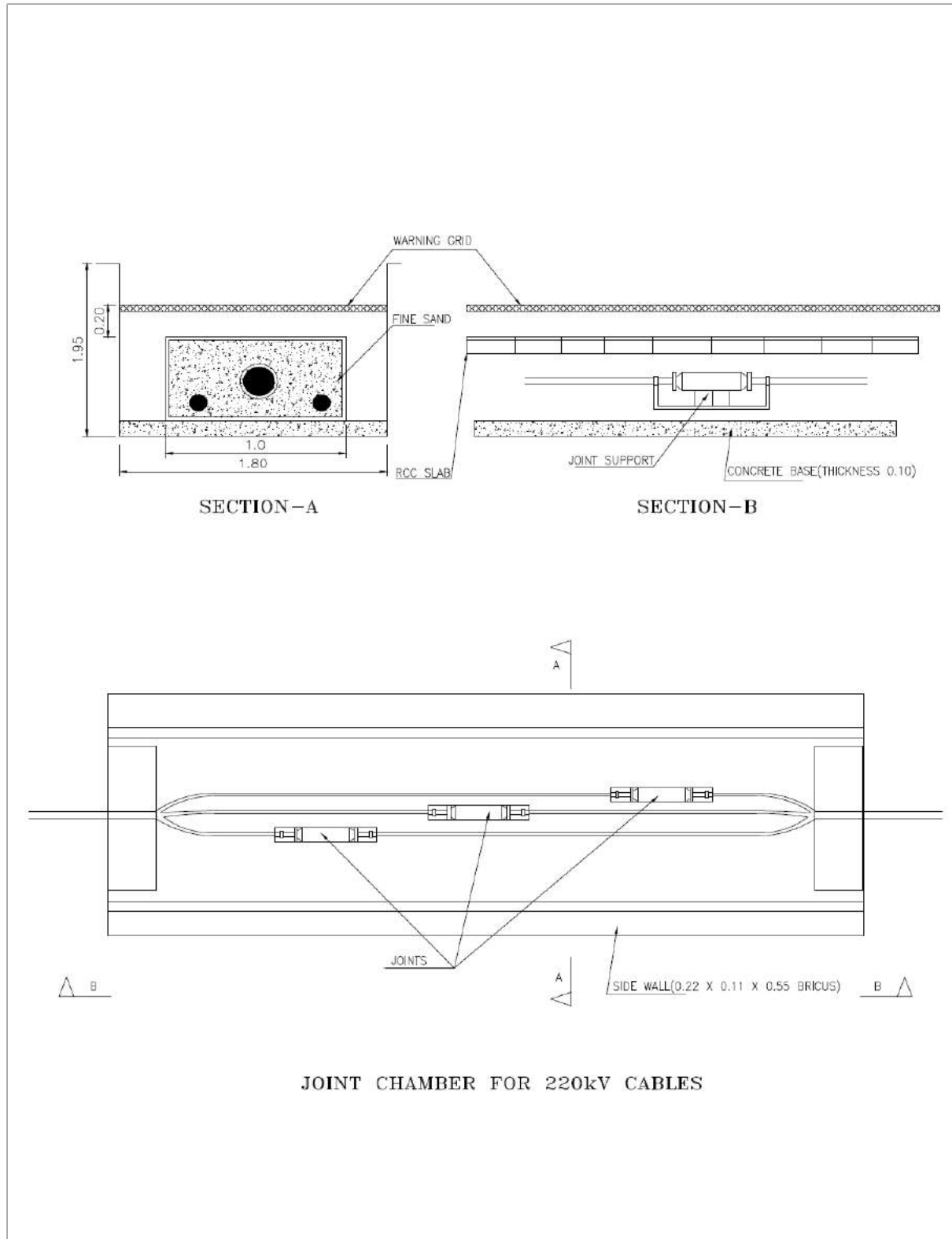
220kV UNDERGROUND
CABLE INSTALLATION
TYPICAL GENERAL ARRANGEMENT
AT NALA CROSSING

Notes

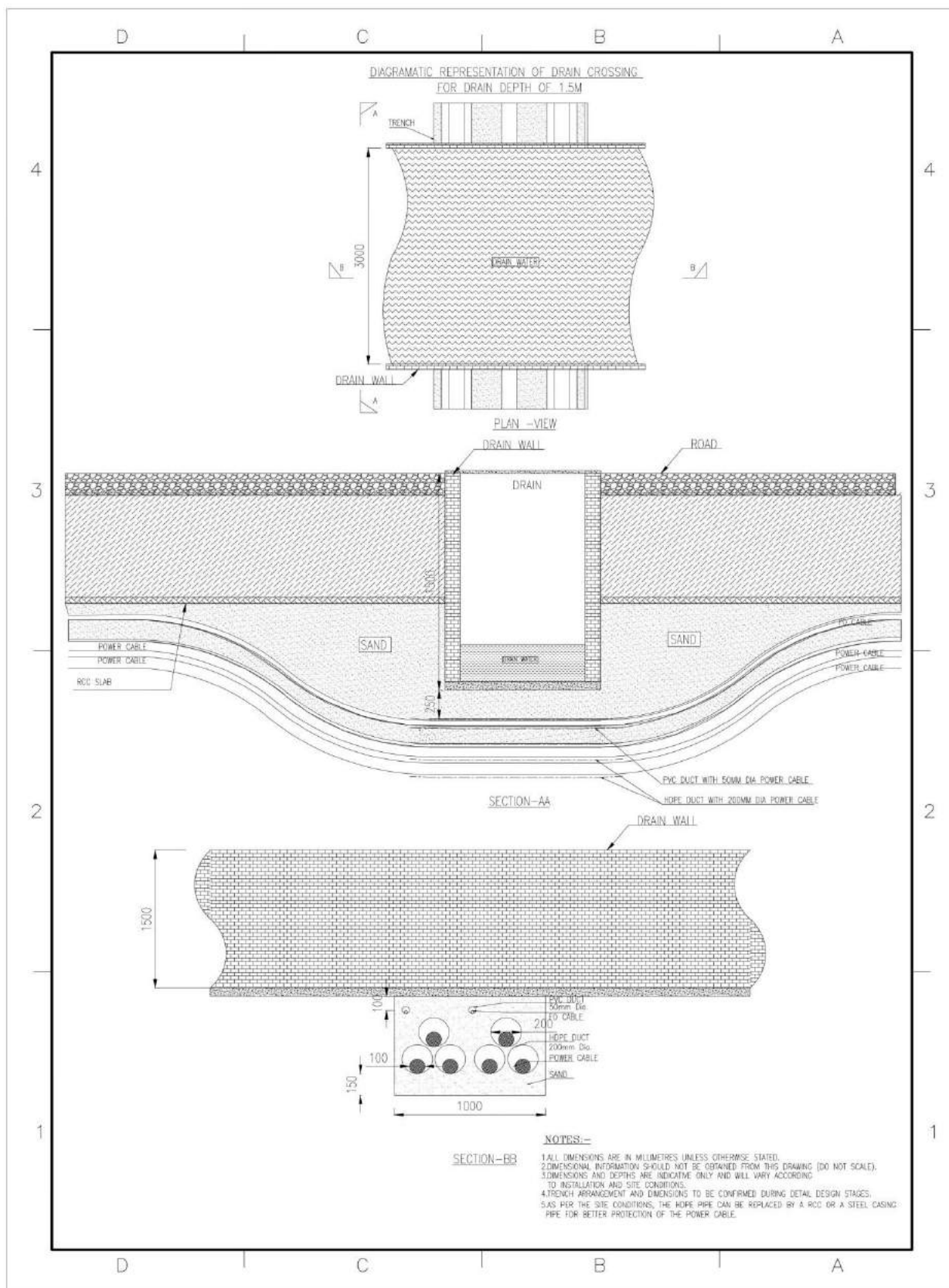
1. All dimensions are in millimetres unless otherwise stated.
2. Dimensional information should not be obtained from this drawing (do not scale).
3. Dimensions are indicative only and will vary according to installation and site conditions.
4. Nala crossing method to be defined depending on specific characteristics and installation conditions. Trench arrangements and dimensions to be confirmed during detail design stage.
5. Nala crossing construction operation will not impinge water flow.
6. Arrangement and dimensions to be confirmed during detail design stages.
7. Depth to be agreed with the relevant stakeholders.

ANNEXURE-4

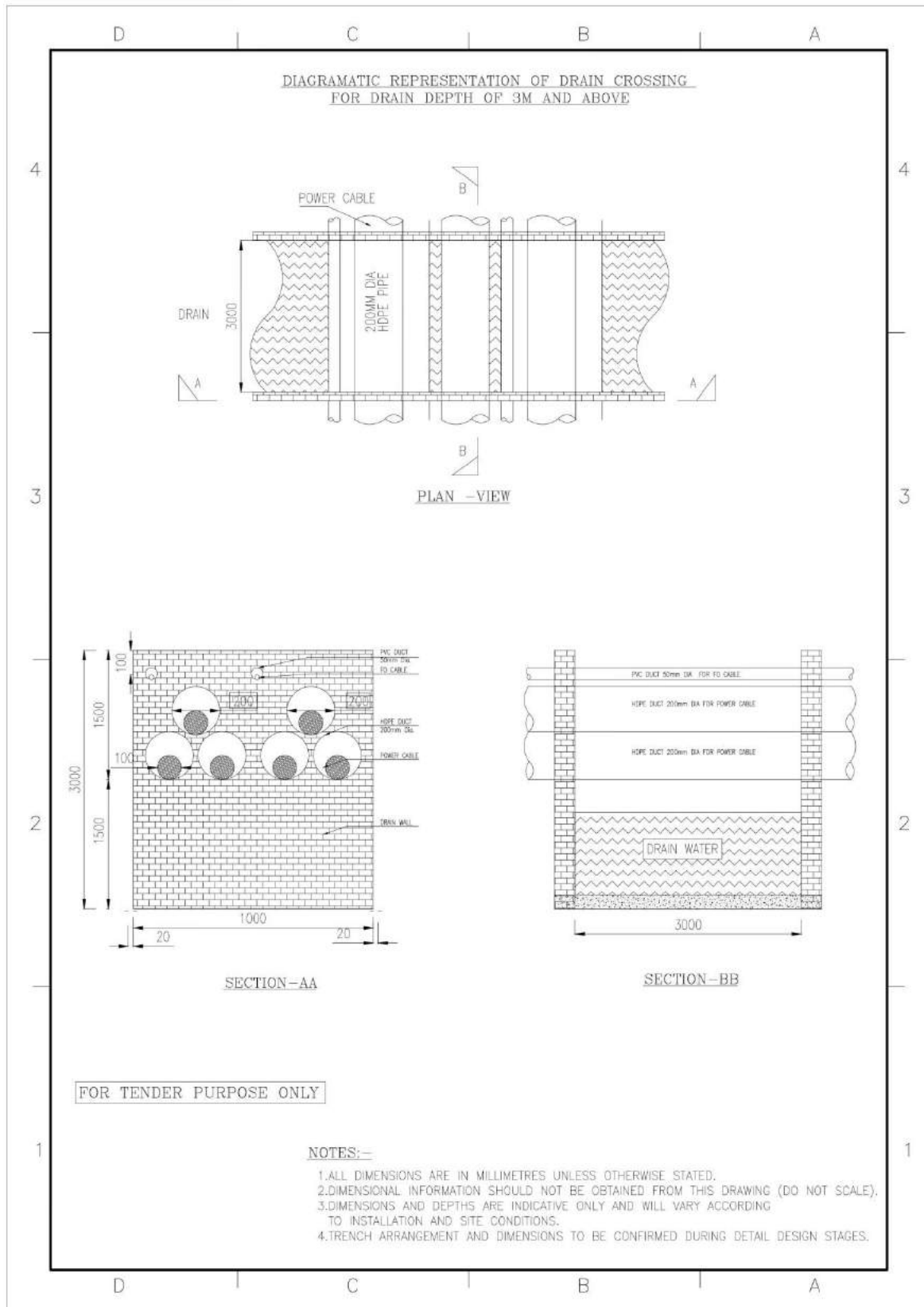
JOINT CHAMBER OF 220kVCABLES (TYPICAL)



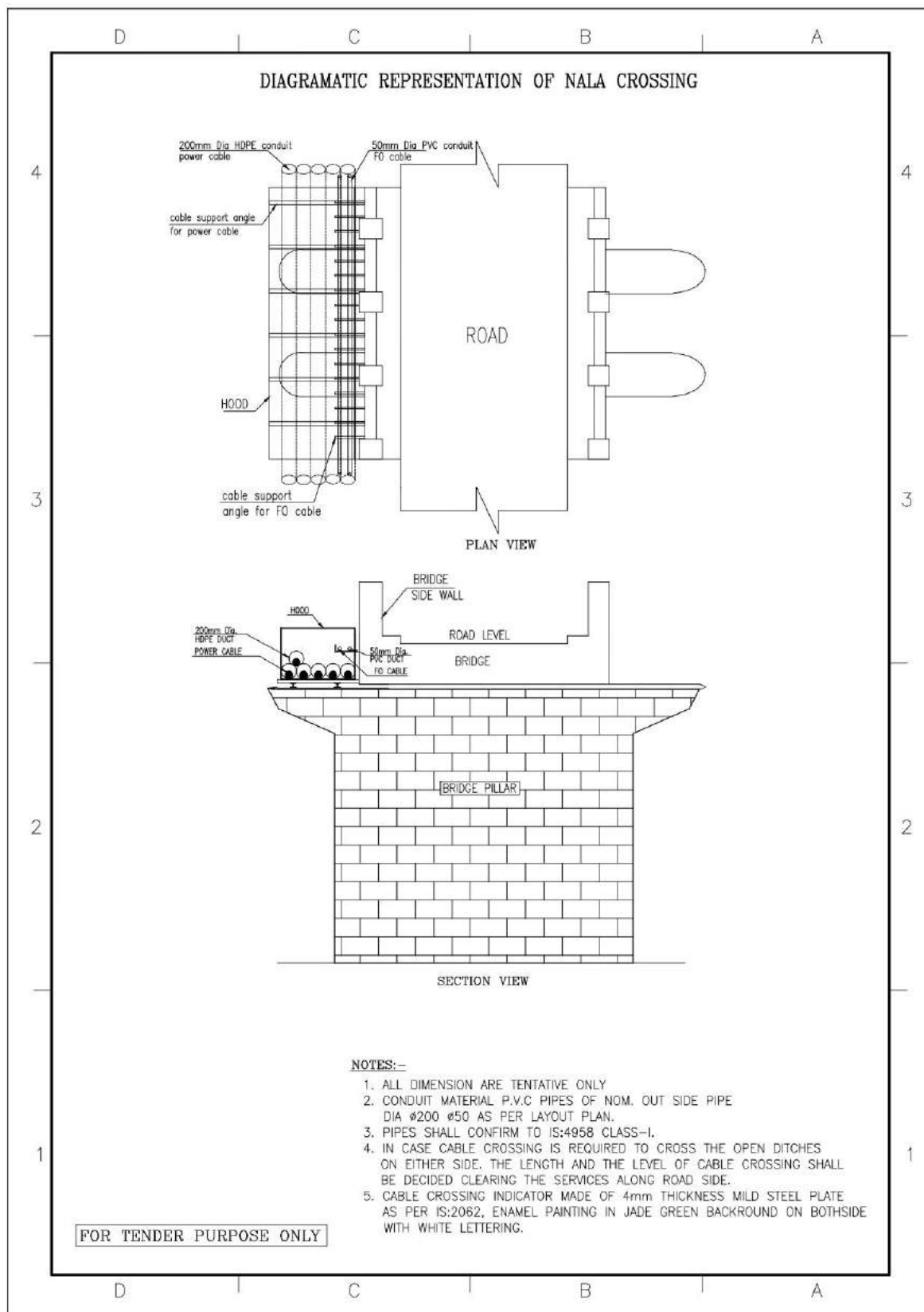
ANNEXURE-5
DRAIN CROSSING FOR 1.5M DEPTH-1

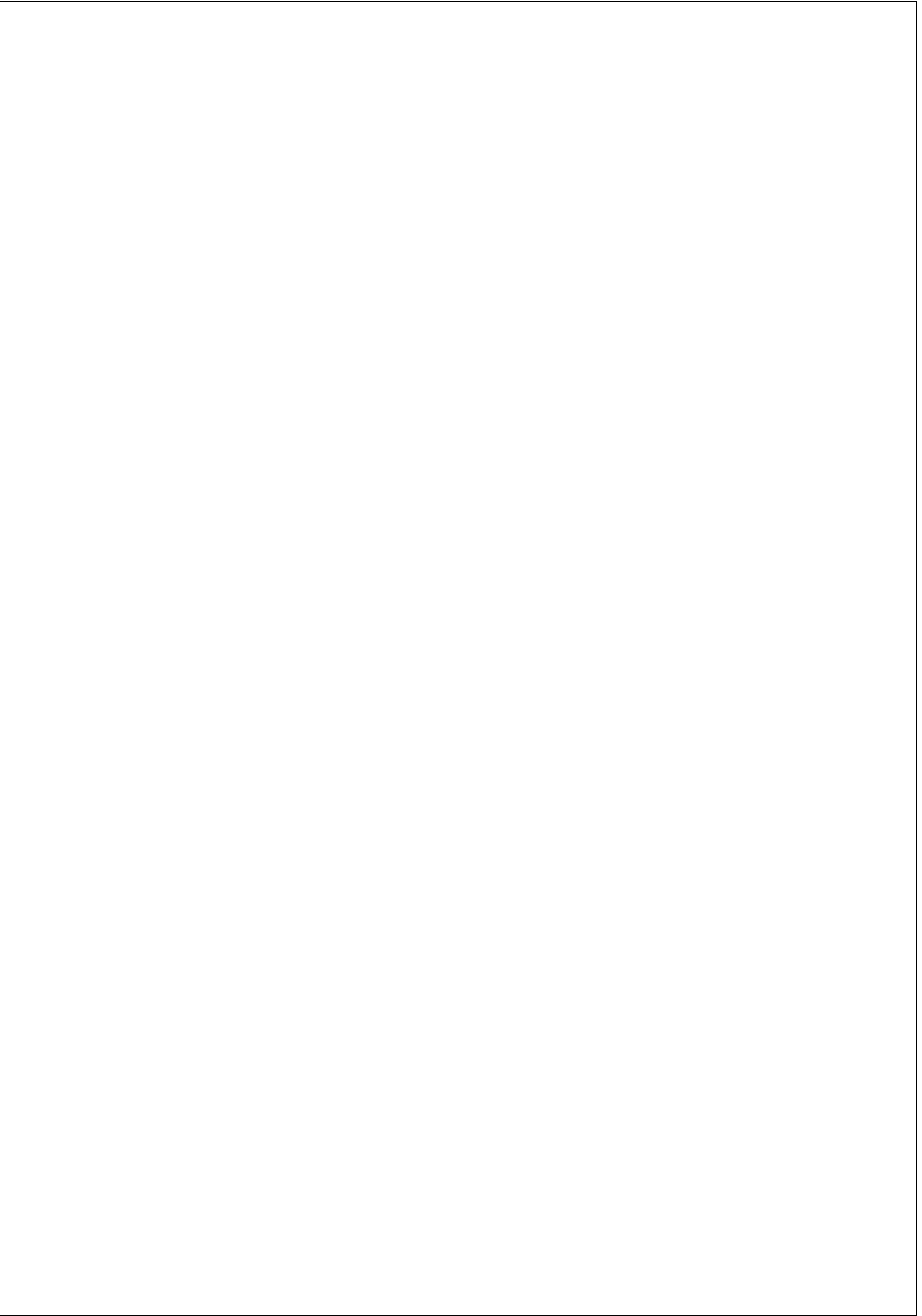


ANNEXURE-6
DRAIN CROSSING FOR 3M DEPTH-1

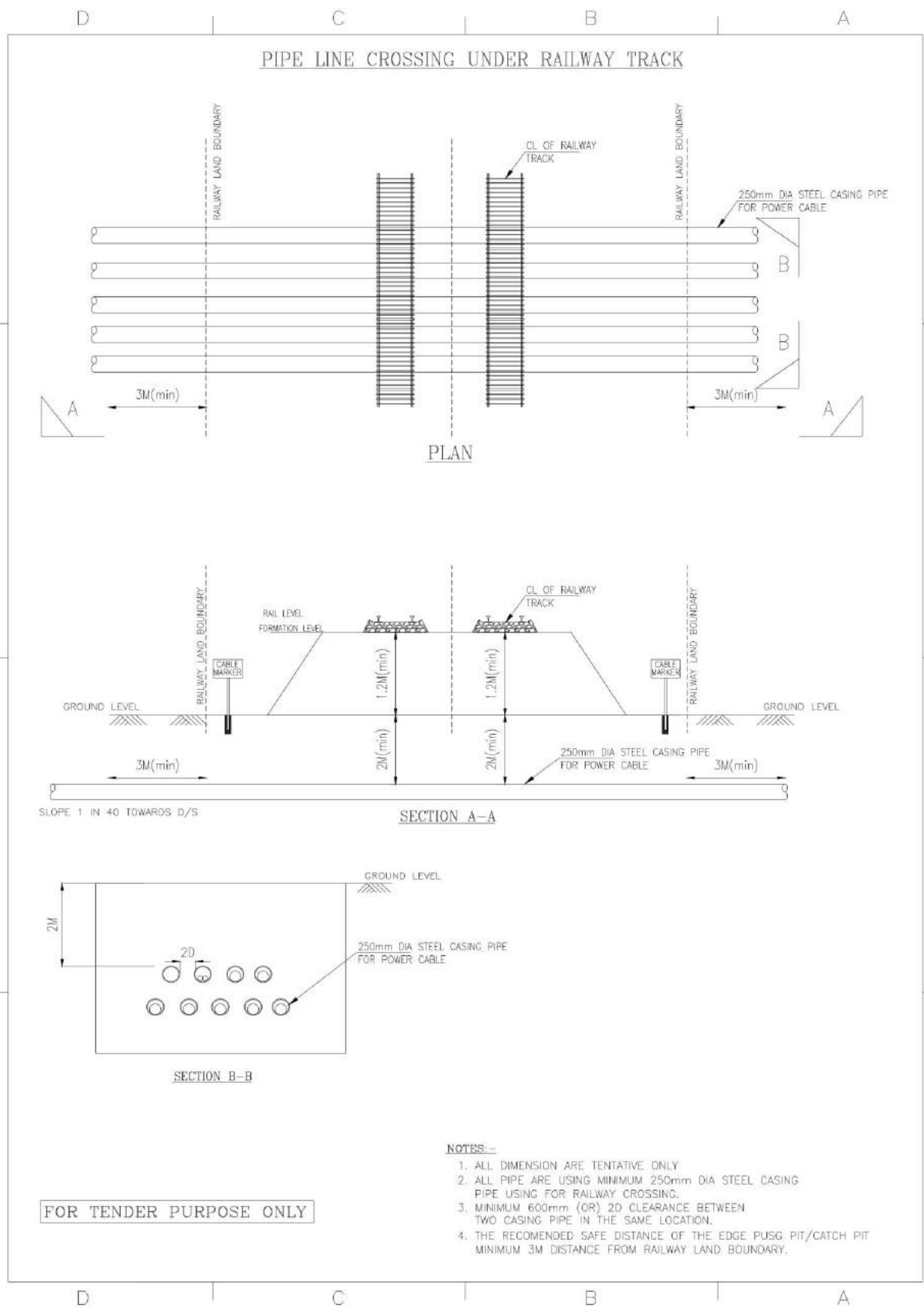


ANNEXURE-7
NALLA CROSSING-2

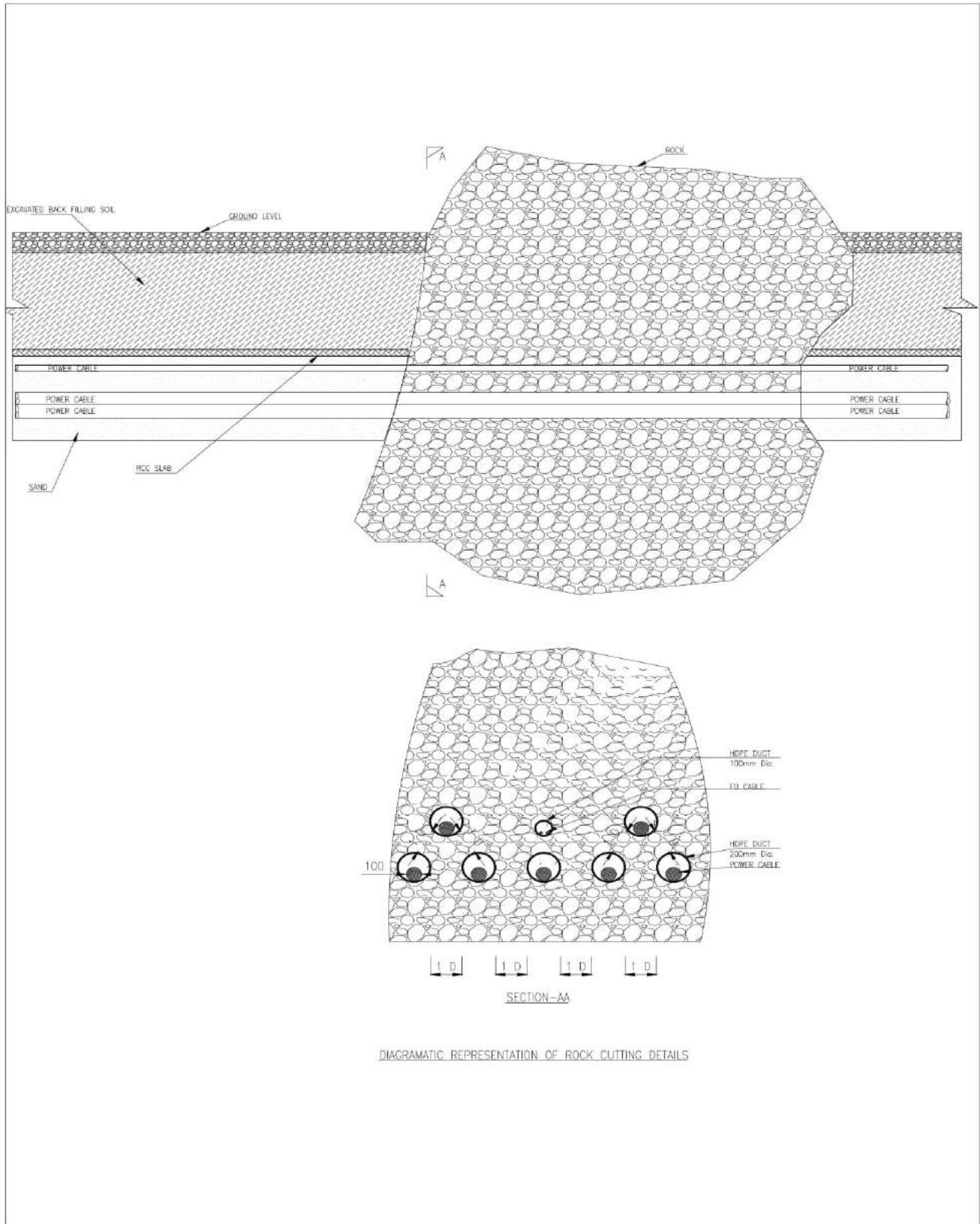




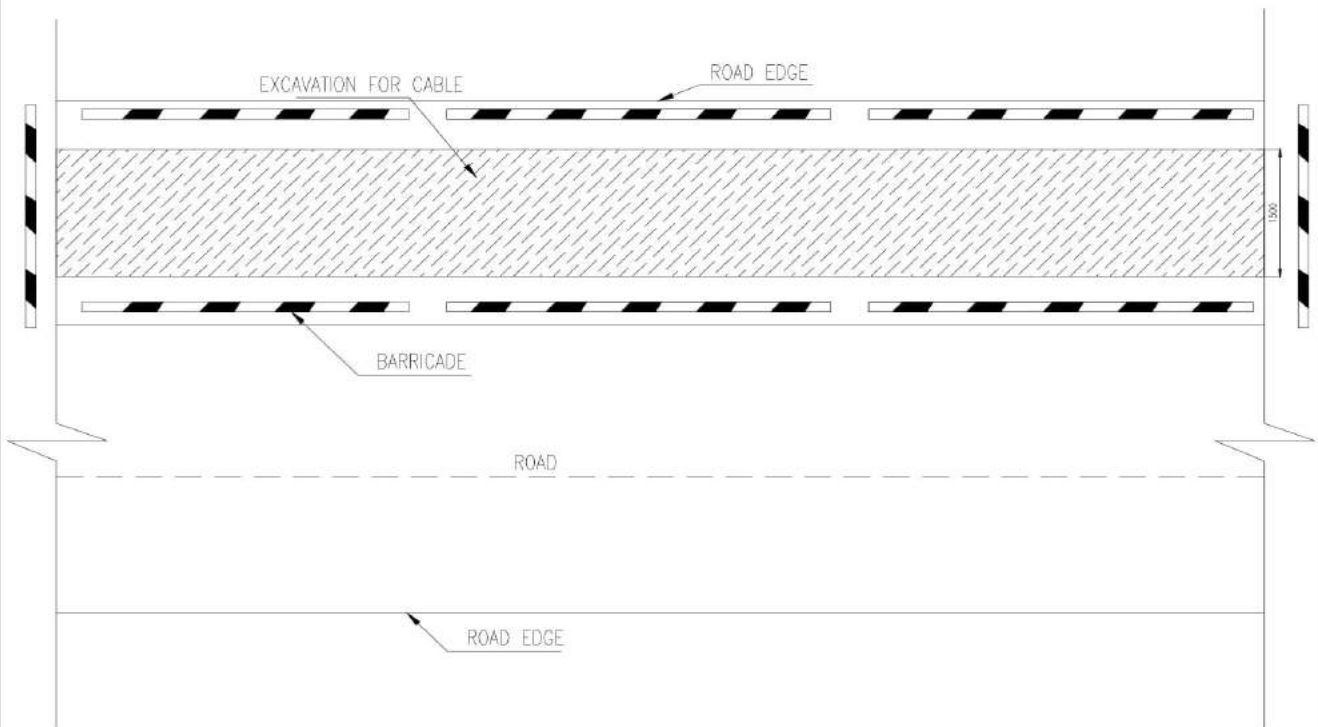
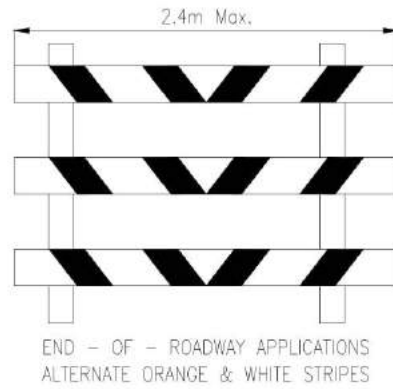
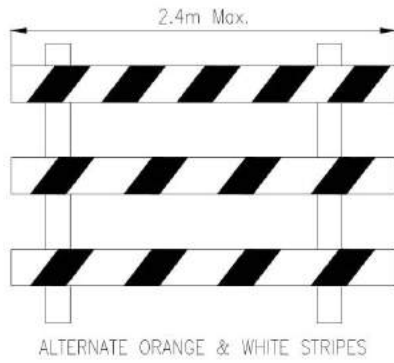
ANNEXURE-8
RAILWAY CROSSING-1



ANNEXURE-09
DIAGRAMMATIC REPRESENTATION FOR ROCK CUTTING OR BORING



ANNEXURE-10
DIAGRAMMATIC REPRESENTATION FOR BARRICADE



DIAGRAMMATIC REPRESENTATION OF BARRECADE

GENERAL TOOLS & TACKLES				
Sl No	Item Description	Unit	Qty	Make / Model
1	Self Supported Cum Extension Ladder at least 6m)	No.	1	Bemico / reputed make
2	Vacuum Cleaner	No.	1	Eureka Forbes / Black & decker / Phillips / Karcher
3	Oil Sample Bottles (500ml)	No.	3	TOSIN
4	Ring Spanner Set	No.	1	Taparia / Bosch / Stanely
5	Tube Spanner Set	No.	1	Taparia / Bosch / Stanely
6	Pipe Wrench 24 "	No.	1	Taparia / Bosch / Stanely
7	Pipe Wrench 18 "	No.	1	Taparia / Bosch / Stanely
8	Hydraulic Crimping Tools upto 630 Sq.mm	No.	1	Taparia / Bosch / Stanely
9	Threading die Set for pipe threading	No.	1	Reputed Make
10	Welding Machine (Arc Welding) 10 KVA	No.	1	Reputed make
11	Heavy Duty Drilling Machine	No.	1	Bosch/Black & Decker (Impact Drill)
12	5 Celled Torch	No.	1	
13	Insulated cutting plier 12"	No.	1	Taparia
14	Insulated cutting plier 8"	No.	1	Taparia
15	line Live Tester	No.	1	
16	Screw Driver 18 "	No.	1	Taparia
17	Screw Driver 12 "	No.	1	Taparia
18	Hammer 8 lbs	No.	1	Taparia / Black & decker / Stanley
19	Hammer 2 lbs	No.	1	-do-
20	Chain Pulley block 5 tonnes	No.	1	Any reputed make having test certificate
21	Pipe Derrick	No.	1	Any reputed make

22	Allen Keys	No.	1	Taparia
23	Box Spanner Set	No.	1	Taparia
24	Screw Driver Set	No.	1	Taparia
25	Handling devices & tools for assembling & dismantling of bays/complete GIS modules	Set	1	Reputed make preferably supplied by GIS OEM
26	Handling devices & tools for assembling & dismantling each type of operating mechanism of circuit breakers, disconnectors & earthing switches.	Set	1	Reputed make preferably supplied by GIS OEM

Kishore
14.3.22
Dy. General Manager (Elect)
Engineering & Quality
OPTCL, Bhubaneswar

[Signature]
Sr General Manager-E&Q
OPTCL, BBSR

Maintenance Testing Equipments				
Sl No	Item Description	Unit	Qty	Make
1	Digital Earth Tester	Nos./Set	1	Megger DET 2/3 / Sonel MRU-120
2	Insulation Tester/Megger (5 KV)	Nos./Set	1	Megger- S1-568 / Fluke 1550C
3	Digital Multimeter	Nos./Set	1 +1=2	Megger / Fluke / Motwane
4 a	Digital Clamp meter	Nos./Set	1	Megger / Fluke / Motwane
4 b	Leakage current clamp meter (30mA / 300mA / 30A / 300A)			Motwane / Sonel / Kyoritsu / Megger
5	Analog Multi-meter	Nos./Set	1	Not Required
6	Universal Computerized Relay Test Kit along with Laptop (Core 2 duo, 2.4 GHz, 15" TFT, 160 GB HDD, 2 GB RAM, DVD R/W) and associated configuration software	Nos./Set	1	Omicron CMC 356 Laptop shall be with Core i5, 10th gen or above with 8GB RAM and 1TB HDD, Genuine Windows 10 or above
7	Dew Point Meter	Nos./Set	1	
8	Contact Resistance Meter	Nos./Set	1	DOBLE / SCOPE / DVPOWER / MEGGER / TETTEX
9	Transformer oil Breakdown Voltage test set	Nos./Set	1	Megger / Baur (100KV test set)
10	Three phase Transformer Turn ratio Tester Meter	Nos./Set	1	TETTEX / MEGGER / DVPOWER
11	SF6 Gas Leakage Detector	Nos./Set	1	DILO / WIKA
12	Circuit Breaker Analyzer	Nos./Set 1116	1	Megger / DV Power / Scope / Doble

13	SF6 Gas Filing and Evacuation Kit	Nos./Set	1	DILO / Mechfield
14	Portable primary injection Test kit	Nos./Set	1	MEGGER/OMICRON / DOBLE
15	Microprocessor Based Dielectric Strength Analyzer	Nos./Set	1	Mentioned above at 9
16	Air/gas humidity tester	no	1	Fluke / PCE
17	Gas purity detector for SO2,H2O etc	no	1	SF6 Gas analyser? DILO / WIKA
18	Gas leakage detector	no	1	Mentioned above at 11
19	Equipment for pressure measurement & gas tightness testing	set	1	

Xinda
14-3-22
General Manager (Elect)
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[Signature]
Sr General Manager-E&Q
OPTCL, BBSR

Furniture

All the furniture shall be of **Godrej Interio** make.

Sl No	Description of items	Unit	Quantity	Model
1	5ftX3ft executive table with drawer both sides	Nos	5	Executive Table T-104
2	4.5ft X 2.5ft Table with one side drawer	Nos	7	T-9
3	Computer table suitable keeping monitor, CPU, UPS and printer with two nos revolving arm chair suitable for computer use.	Set	1	STYLO Table + 2 nos AERO Mid back chairs
4	Executive revolving, adjustable (height) chairs with arm	Nos	5	AERO High Back
5	Cushion fixed "S" type steel chairs with arm	Nos	18	Premier
6	6ftX3ft conference table	Nos	1	Talk unitised 8 seater
7	Cushion arm steel chairs for conference table purpose.	Nos	6	AERO Mid back
8	6ft height steel almirah (only with selves) for keeping records and other valuable items.	Nos	4	Storwel Plain
9	6ft height steel almirah with glass doors for library purpose	Nos	2	Glass door Storwel (2 door)
10	6ft height (having minimum 6 lockers facility) steel cupboard with locking arrangement.	Nos	2	
11	4ft steel rack (minimum three selves) for keeping the files and other items.	Nos	8	

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14-3-22
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14/3
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Annexure I

OPTCL Approved Make List

Provisionally Approved Vendor list of OPTCL for supplying materials to the contractors, awarded with total turnkey / partial turnkey projects of OPTCL Valid up to 30.04.2026

Breaker

Breaker (up to 400 KV Spring-Spring,SF-6)	1	M/s Hitachi Energy India Ltd., Gujarat
	2	M/s CG Power and Industrial Solutions Ltd, Nasik
	3	M/s. Siemens Limited, Kolkata

PCVCB

33 KV Spring-Vacuum, 1600A, 25 kA	1	M/s CG Power and Industrial Solutions Ltd, Nasik
	2	M/s. Stelmec Limited, Mumbai

CT

CT of 0.2S Accuracy class up to 400 KV	1	M/s CG Power and Industrial Solutions Ltd, Nasik (Only Polymer Type)
	2	M/s Hitachi Energy India Ltd., Gujarat (Only Polymer type)
CT of 0.2S Accuracy class up to 220 KV	1	M/s.Heptacare Power Industries Pvt. Ltd., Meerut (Polymer/ Porcelain type)
	2	M/s Mehru Electrical & Mechanical Engineers (P) Ltd, Bhiwadi (Polymer/ Porcelain type)
CT of 0.2S Accuracy class up to 132 KV	1	M/s Pragati Electricals Pvt Ltd, Navi Mumbai (Polymer/ Porcelain type)
	2	M/s CG Power and Industrial Solutions Ltd, Nasik (Polymer/ Porcelain type)
	3	M/s Hitachi Energy India Ltd., Gujarat (Polymer/ Porcelain type)
	4	M/s Kapco Electric Pvt. Ltd, Noida (Polymer/ Porcelain type)
	5	M/s. Siemens Limited, Kolkata (Polymer/ Porcelain type)

PT (IVT)

PT/ IVT of 0.2S Accuracy class (Porcelain/ Polymer) up to 400 KV	1	M/s CG Power and Industrial Solutions Ltd, Nasik
	2	M/s. Siemens Limited, Kolkata
PT/ IVT of 0.2S Accuracy class (Porcelain/ Polymer) up to 220 KV	3	M/s.Heptacare Power Industries Pvt. Ltd, Meerut
	4	M/s SCT Ltd., Ghaziabad, UP
	5	M/s Mehru Electrical & Mechanical Engineers (P) Ltd, Rajasthan
PT/ IVT of 0.2S Accuracy class (Porcelain/ Polymer) up to 132 KV	6	M/s Pragati Electricals Pvt Ltd, Navi Mumbai
	7	M/s Kapco Electric Pvt. Ltd, Noida

Surge Arrestor/ LA

Surge Arrestor (Polymer Type) up to 400 KV	1	M/s CG Power and Industrial Solutions Ltd, Nasik
	2	M/s Oblum Electrical Industries Hyderabad
Surge Arrestor (Polymer type) up to 220 KV	1	M/s Elecktrolites (Power) Pvt. Ltd, Jaipur

CVT

CVT of 0.2 accuracy class up to 400 KV (Porcelain /Polymer type)	1	M/s Hitachi Energy India Ltd., Gujarat
	2	M/s CG Power and Industrial Solutions Ltd, Nasik
	3	M/s. Siemens Limited, Kolkata
CVT of 0.2 accuracy class up to 132 KV	1	M/s Mehru Electrical & Mechanical Engineers (P) Ltd, Rajasthan

Hardware fitting		
Hardware fitting up to 400KV	1	M/s Supreme & Company Pvt. Ltd., Kolkata
	2	M/s Electromech & Transtech Pvt. Ltd., Kolkata
	3	M/s Krsna Transmission Hardware Mfg. Pvt. Ltd, Vadodara
	4	M/s IAC Electricals Pvt. Ltd, Kolkata
	5	M/s Legion Energy, Bangaluru
Hardware fitting up to 220KV	1	M/s. Jainco Transmission Limited,
	2	M/s Aumni Transmission Industry Pvt. Ltd, Vadodara,
Clamp & Connectors		
Clamp and Connector up to 400 KV	1	M/s Legion Energy, Bangaluru
	2	M/s Exalt Engineering Industries, Mumbai
	3	M/s Supreme & Company Pvt. Ltd., Kolkata
	4	M/s IAC Electricals Pvt. Ltd, Kolkata
	5	M/s Electromech & Transtech Pvt. Ltd., Kolkata
Clamp and Connector up to 220 KV	1	M/s Krsna Transmission Hardware Mfg. Pvt. Ltd, Vadodara
	2	M/s. Jainco Transmission Limited, Kolkata
	3	M/s Aumni Transmission Industry Pvt. Ltd, Vadodara,
Spacers		
Spacers upto 400kV		M/s IAC Electricals Pvt. Ltd, Kolkata
Spacers upto 220kV		M/s. Jainco Transmission Limited, Kolkata
Conductor		
Conductor (ACSR –Moose, Zebra, Panther, Bersimisi & AAAC-Moose, Zebra & Panther)	1	M/s Lumino Industries Ltd, Kolkata
	2	M/s Mahavir Transmission Limited, Noida
	3	M/s Gupta Power Infrastructure Limited, Bhubaneswar
	4	M/s Galaxy Transmissions Pvt. Limited, Sangli
Conductor (ACSR - Moose, Zebra, Panther & AAAC-Moose, Zebra, Panther)	1	M/s Dynamic Cables Private Ltd, Jaipur
	2	M/s Cabcon India Limited, Kolkata
	3	M/s Anvil Cables Pvt. Ltd., Kolkatta
ACSR (Moose, Zebra and Panther)	1	M/s Nirmal Wires Pvt. Ltd, Kolkata
GI Earthwire		
GI Earthwire (7/3.15 mm & 7/3.66 mm)	1	M/s Nirmal Wires Pvt. Ltd, Kolkata
	2	M/s Cabcon India Limited, Kolkata
OPGW Cable with Hardware Accessories		
OPGW Cable Hardware fittings , splice Enclosure (Joint Box) 24F/48F/96F, FODP, 48F/96F	1	M/s Krsna Transmission Hardware Mfg. Pvt. Ltd, Vadodara
	2	M/s IAC Electricals Pvt. Ltd., Howrah
	3	M/s Legion Energy Products Pvt. Ltd., Bengaluru
OPGW Hardware Accessories	1	M/s Aumni Transmission Industry Pvt. Ltd, Vadodra,
INSULATORS		
Porcelain Long rod Insulators & Solid core Post Insulators	1	M/s Modern Insulators Limited, Rajasthan

Composite Polymer Insulator & Composite Polymer Bus Post Insulator up to 400 KV	2	M/s Deccan Enterprises Ltd, Hyderabad
Porcelain Disc Insulator (160KN, 120KN, 90KN), Antifog & Normal TYPE	1	M/s Imperial Ceramics Pvt. Ltd., Bikaner
	2	M/s Bikaner Ceramics Private Limited, Bikaner
	3	M/s Allied Ceramics Pvt. Ltd, Kolkata
	4	M/s Grasim Industries Limited, , West Bengal
Porcelain Disc Insulator / Porcelain Bus Post Insulator	1	M/s Insulators& Electricals Company, New Delhi
Composite polymer Insulator (up to 400 KV-160 KN)”	1	M/s Shree Radhe Industries, Vadodara
Composite Polymer Insulator (up to 220KV-120KN)”	1	M/s Yamuna Power & Infrastructure Limited, Jagadhri, Haryana
Solid Core post Insulator	1	M/s CJI Porcelain Pvt. Ltd., UP
ISOLATORS		
ISOLATOR up to 400KV	1	M/s.Switchgears & Structural (India) Pvt. Ltd, Hyderabad
ISOLATOR up to 220KV	1	M/s.Switchgears Manufacturing Company Pvt Ltd, Hyderabad
	2	M/s JDE Switchgear Pvt. Ltd., Howrah
	3	M/s Elektrolites (Power) Pvt. Ltd., Jaipur
Battery Charger		
220 V Battery Charger for VRLA & Plante Type	1	M/s Voltech Manufacturing Company Ltd, Chennai
EHV Grade XLPE Cable (both Al & Cu)		
EHV Grade XLPE Cable (both Al & Cu) up to 220KV	1	M/s Universal Cables Ltd., Kolkata
	2	M/s KEC International Limited, Kolkatta
EHV Grade XLPE Cable (both Al & Cu) up to 132KV	1	M/s Finolex J-Power Systems Pvt. Ltd, Pune
EHV Grade XLPE Cable (Both Al & Cu) up to 33 KV	1	M/s Dynamic Cables Private Ltd, Jaipur
	2	M/s Havells India Ltd, Bhubaneswar
	3	M/s Gemcab Industries Ltd, New delhi
Cable End termination Kit for 220kV/132kV/33kV		
Cable end termination Kit up to 33 KV	1	M/s Yamuna Cable Accessories Pvt. Limited, Haryana
Station Transformer		
Station Transformer (33/0.433 KV) up to 500 KVA	1	M/s Orissa Transformers Pvt. Ltd., Bhubaneswar
Station Transformer (33/0.433 KV) up to 1000 KVA	1	M/s Voltech Manufacturing Company Ltd, Kanchipuram

CONTROL, PROTECTION & SAS SYSTEM		
Control, Protection & SAS System Upto 400kV	1	M/s Hitachi Energy India Ltd., Bengaluru
	2	M/s. Siemens Limited, Kolkata
Conventional Control & Relay Panel, Event Logger, Disturbance Recorder (up to 220 KV)	1	M/s Voltech Manufacturing Company Ltd., Bengaluru
Conventional Control & Relay Panel, Event Logger, Disturbance Recorder (up to 33 KV)	1	M/s. Stelmec Limited, Mumbai
	2	M/s CG Power and Industrial Solutions Ltd, Nasik
Conventional Control & Relay Panel up to 220kV	1	M/s Schneider Electric Infrastructure Ltd, Bhubaneswar
NUMERICAL RELAYS, IEC-61850 & AUXILIARY RELAYS		
NUMERICAL RELAYS, IEC-61850 & AUXILIARY RELAYS up to 33 KV	1	M/s CG Power and Industrial Solutions Ltd, Nasik
GIS Equipment for Indoor sub station		
GIS Equipment for Indoor GIS Sub Station up to 400 KV	1	M/s. Siemens Limited, Kolkata
ACDB /DCDB / BMK / CONSOLE BOX		
ACDB /DCDB / BMK / CONSOLE BOX	1	M/s United Engineers Pvt Ltd, Bhubaneswar
	2	M/s. Bose Engineering (India) Pvt. Ltd, Kolkata
	3	M/s S R Automation Pvt. Ltd, Kolkata
	4	M/s AIM Engineering Industries, Kolkata
	5	M/s Control Devices, Kolkata-
	6	M/s. S.K .Engineers India Pvt. Limited, Bhubaneswar
	7	M/s Technocrat Enterprises, Cuttack
	8	M/s Nitya Electrocontrols Pvt Ltd, Noida
LT XLPE Cable of 1100 V		
LT XLPE Cable of 1100 V	1	M/s Vishal Cables Pvt. Ltd, Mumbai-
	2	M/s Zenium Cables Ltd, Mumbai-
	3	M/s Havells India Ltd, Bhubaneswar
	4	M/s Prime Cable Industries Pvt Ltd, Delhi
	5	M/s Alpha Communication Ltd, Delhi
	6	M/s Gupta Power Infrastructure Limited, Bhubaneswar
	7	M/s. Gloster Cables Ltd, Secunderabad
	8	M/s Universal cables Ltd, Kolkata
	9	M/s Cabcon India Limited, Kolkata
	10	M/s Dynamic Cables Private Ltd, Jaipur,
PVC INSULATED POWER & CONTROL CABLES (with Type-C Insulation)		
PVC INSULATED POWER & CONTROL CABLES (with Type-C Insulation)	1	M/s Dynamic Cables Private Ltd, Jaipur,
	2	M/s Prime Cable Industries Delhi
	3	M/s Universal cables Ltd, Kolkata
	4	M/s Zenium Cables Ltd, Mumbai

	5	M/s Vishal Cables Pvt. Ltd, Mumbai
	6	M/s Cabcon India Limited, Kolkata
	7	M/s. Gloster Cables Ltd, Secunderabad
	8	M/s Alpha Communication Ltd, Delhi
	9	M/s Gupta Power Infrastructure Limited, Bhubaneswar
	10	M/s Gemcab Industries Ltd, New delhi
Digital Tele-protection Coupler		
Digital Tele-protection Coupler	1	M/s M/s Hitachi Energy India Ltd, Bengaluru
	2	M/s. Siemens Limited, Kolkata
Fibre Optic Terminal Equipment/GPRS (SDH Equipment)(STM-4/STM-16/STM-64) & GPRS Modem	1	M/s Commtel Networks Pvt Ltd , Navi Mumbai
RTU		
RTU Conforming to IEC Protocols in Use in OPTCL system	1	M/s Hitachi Energy India ltd., Bengaluru
	2	M/s. Siemens Limited, Kolkata

NB:-

1. Presently all the Vendors enlisted for "TOWER & STRUCTURES FOR LINE AND SUBSTATION AND FOUNDATION BOLT" were Cancelled as per recommendation of 115th BoD held on 20.10.2020. However the EPC contractors may be insisted to place order for supply of structural materials from approved rate contract holder of OPTCL.
2. Brand names of lighting fixtures and Steel are to be decided by E&QC Department and the same shall be mentioned in the Tender documents.
3. All the provisionally approved vendors to submit their Drawings & Type test report in D3 portal for scrutiny and approval by E& QC Department.


 23.06.2023
 SENIOR GENERAL MAGAGER (CPC)

Annexure II

Project Bill of Quantities

Substation & 220kV Cabling Works – Supply

Substation & 220kV Cabling Works – Erection

Substation & 220kV Cabling Works – Civil Works

Sl. No.	Item Description	Quantity	Units
1	2	3	4
1	SCHEDULE 2A-SS (SUPPLY)		
1.01	220/33kV, 20MVA, YNyn0, 3 phase Power Transformer with complete Accessories including first oil filling with 10% extra oil and Digital RTCC panel Complete in all respect.	1.00	Nos
2.0	245kV GIS EQUIPMENT as per latest IEC standard & type tested equipment as per technical specification, with open future proof & flexible system in line with IEC 61850 & IEC 62271-203. (Circuit breaker shall be C2-M2 class as per IEC 62271-100).		
2.01	245kV, 3150A, 50kA (3 sec for CB & 1 sec for Disconnecter, Grounding switch, CT, PT), SF6 gas insulated Transformer feeder bay module each comprising of SF6 gas insulated circuit breaker, current transformer, bus-bar dis connectors with common grounding switch, Motorised dis connectors with safety grounding switch(es), high speed fault making motorised grounding switch, Stand alone Local control cubicle, SF6 gas monitoring system for complete bay, SF6 bus duct termination arrangement, PD sensor (adequate number of UHF sensors in the offered GIS equipment for detection of Partial discharge (of 5 pC and above) as per IEC 60270 through Partial Discharge (PD) monitoring system), different gas compartment, O- ring & gaskets, Nuts, Bolts & Washers Absorbent, Limit Switch, SF6 Gas, etc to complete Transformer feeder bay module & its earthing arrangement with earthing strips of adequate size as per the technical specification.	1.00	SET
2.02	245kV, 3150A, 50kA (3 sec for CB & 1 sec for Disconnecter, Grounding switch, CT & PT), SF6 gas insulated Line feeder bay module each comprising of SF6 gas insulated circuit breaker, current transformer, Line Potential Transformer (3 core), bus-bar dis connectors with common grounding switch, Motorised dis connectors with safety grounding switch(es), high speed fault making motorised grounding switch, Stand alone Local control cubicle, SF6 gas monitoring system for complete bay, SF6 bus duct termination arrangement, PD sensor (adequate number of UHF sensors in the offered GIS equipment for detection of Partial discharge (of 5 pC and above) as per IEC 60270 through Partial Discharge (PD) monitoring system), different gas compartment, O- ring & gaskets, Nuts, Bolts & Washers Absorbent, Limit Switch, SF6 Gas, etc to complete line feeder bay module & its earthing arrangement with earthing strips of adequate size as per the technical specification.	4.00	SET
2.03	245kV, 3150A, 50 kA (3 sec for Bus bar, 1 sec for disconnecter, grounding switch & bus P.T), 3- phase Isolated, SF6 gas insulated, Metal enclosed bus bars each enclosed in bus enclosures running along the length of the switchgear to interconnect each of circuit breaker bay module. Each bus bar set shall be complete with bus potential transformer (3 core), dis connectors, bus bar grounding switch, SF6 gas monitoring system PD sensor (adequate number of UHF sensors in the offered GIS equipment for detection of Partial discharge (of 5 pC and above) as per IEC 60270 through Partial Discharge (PD) monitoring system), different gas compartment, O- ring & gaskets, Nuts, Bolts & Washers Absorbent, Limit Switch, SF6 Gas, etc to complete the bus & its earthing arrangement with earthing strips of adequate size (as per IEEE-80-2000 and CIGRE44 to protect operating staff against any hazardous touch voltages and electro-magnetic interferences) as per the technical specification.	2.00	SET
2.04	SF6 gas insulated Bus Coupler Bay Module comprising of SF6 gas insulated circuit breaker, current transformer, dis connectors switches, disconnecter with safety grounding switch(es). Local control cubicle, SF6 gas monitoring system, PD sensor (adequate number of UHF sensors in the offered GIS equipment for detection of Partial discharge (of 5 pC and above) as per IEC 60270 through Partial Discharge (PD) monitoring system), different gas compartment, O- ring & gaskets, Nuts, Bolts & Washers Absorbent, Limit Switch, SF6 Gas, etc to complete Bus Coupler bay module & its earthing arrangement with earthing strips of adequate size (as per IEEE-80-2000 and CIGRE44 to protect operating staff against any hazardous touch voltages and electro-magnetic interferences) as per the technical specification.	1.00	SET
2.05	245kV, 3150A, 50kA, 3 sec, single phase, SF6 gas Insulated Bus Duct outside GIS Hall alongwith associated Support structure arrangement bends, joints, accessories, & its earthing arrangement with earthing strips of adequate size (as per IEEE-80-2000 and CIGRE44 to protect operating staff against any hazardous touch voltages and electro-magnetic interferences) as per the technical specification etc.	480.00	RM
2.06	245kV, 3150A, 50kA SF6/Air Bushing (Bushing shall be of Polymer / composite insulator type and shall be seamless sheath of a silicone rubber compound. The hollow silicone composite insulators shall comply as per IEC 61462 and the relevant parts of IEC 62217. The design of the composite insulators shall be tested and verified according to IEC 61462).	15.00	Nos
2.07	Portable Partial Discharge(PD) monitoring system: 245kV system shall have Portable Partial Discharge(PD) monitoring system & shall be capable for measuring PD in charged GIS environment, bandwidth in order of 100 MHz-2GHz & provision to select a wide range of intermediate bandwidths and the principle of operation shall be based on UHF principle of detection. The Detection and measurement of PD and bouncing particles having in built large coloured LCD for displaying and storing facility in the instrument for further analysis to locate actual source of PD such as free conducting particles, floating components, voids in spacers, particle on spacer surfaces etc.	1.00	SET
3.00	250kVA, 380BHP, 220kW, Silent AMF Diesel Generator set, 1500 rpm with AMF control panel as per Technical Specification.	1.00	SET
4.0	220kV OUTDOOR EQUIPMENTS:		
4.01	245kV, 50kA/1Sec, 1 Core, CL-0.2, 50VA Single Phase Potential Transformer (AIS) for Metering	6.00	Nos
4.02	PT Console Box for above PTs as above	2.00	Nos
4.03	245kV, 50kA/1Sec, 5 Core, 1200-600-300/1A, CL-PX, 0.2S, 30VA Single Phase Current Transformer (AIS) for Metering	6.00	Nos
4.04	CT Console Box for above CTs as above	2.00	Nos
4.05	245kV, 3150A, 50kA/1sec, Double Break Isolator (Isolator with earth switch including post insulators for incomer)	2.00	SET
4.06	220kV, Cable Sealing End (220kV GIS END)	6.00	Nos
4.07	220kV, Cable GIS end termination kit at (MRSS Substation End)	6.00	Nos
4.08	216kV Metal Oxide Surge Arrestor, 10kA, Long duration discharge class III, 10kJ/kV at 216kV as per technical Specification	15.00	Nos
5.0	33kV OUTDOOR EQUIPMENTS:		
5.01	33kV, 1250A, 31.5kA/3s, 3 Phase, Outdoor Vacuum Circuit breaker with Supporting Structure	4.00	Nos
5.02	33kV Single Phase Current Transformer for 20MVA Power transformer, 5 core, ratio: 800-400-200/1A	3.00	Nos

5.03	CT Console Box for above CTs	1.00	Nos
5.04	33kV Single Phase Current Transformer for 33kV Feeder & 33kV Buscoupler, 3 core, ratio: 800-400-200/1A	9.00	Nos
5.05	CT Console Box for above CTs	3.00	Nos
5.06	33kV Single Phase, Bus Potential Transformer, 2 core (0.2,3P classes), 33kV/110V/110V	3.00	Nos
5.07	PT Console Box for above PTs	1.00	Nos
5.08	33kV Single Phase, Metering Current Transformers for 33kV feeder bays, 1 core, 800-400-200/1A	6.00	Nos
5.09	CT Console Box for above CTs as above	2.00	Nos
5.10	33kV Single Phase, Metering Potential Transformers for 33kV feeder bays, 1 core, 33kV/110V	6.00	Nos
5.11	PT Console Box for above PTs	2.00	Nos
5.12	33kV, 1250A, 31.5kA/1s, Outdoor Isolator W/O Earth Switch	8.00	Sets
5.13	33kV, 1250A, 31.5kA/1s, Outdoor Isolator with Earth Switch	5.00	Sets
5.14	33kv, 200A, Horn Gap fuses	2.00	Sets
5.15	30kV Metal Oxide Surge Arrestor, 10kA, Long duration discharge class III as per technical Specification.	15.00	Nos
5.16	33kV Bus Post Insulator	10.00	Nos.
6.00	Tariff Meter for Main & Check meter for Metering	8.00	Nos
7.0	XLPE Power Copper conductor cable for the GIS system (36kV class) and cable termination kit		
7.01	36kV XLPE Cable 300 sq. mm Copper Single Core (from 33kV side TFL feeder End termination to 33kV Double pole structure having each phase one run)	0.85	Krms
7.02	36kV Outdoor type termination Kits (from TFL feeder to 33kV Double pole structure) suitable for 1CX300 Sq.mm	12.00	Nos
8.0	BUS BAR & CIRCUIT MATERIALS		
8.1	Long Rod Silicon Composite Insulator		
8.11	160kN Long rod Insulator strings for 245kV tension purpose	6.00	Sets
8.12	160kN Long rod Insulator strings for 245kV Suspension purpose	6.00	Sets
8.13	120kN Long rod Insulator strings for 33kV tension purpose	36.00	Sets
8.14	90kN Long rod Insulator strings for 33kV Suspension purpose	30.00	Sets
8.20	Single ACSR Moose Conductor:	0.95	Km
8.3	HARDWARES & FITTINGS/SPACERS/CLAMP & CONNECTORS		
8.31	220kV Single Tension H/W fitting for single moose ACSR	6.00	Nos
8.32	220kV Single Suspension H/W fitting for single moose ACSR	6.00	Nos
8.33	Clamps & Connectors etc: 220kV T- clamp for ACSR ZEBRA to ACSR MOOSE drop,220kV Isolator pad clamp suitable for ACSR Moose conductor,3 bolted PG clamp suitable for ACSR Moose conductor,220kV LA Clamp suitable for ACSR Moose, 30kV LA Clamp suitable for ACSR Moose. etc as required.		
8.331	Terminal connector for power transformer to receive ACSR conductor suitable for horizontal take off	3.00	Nos
8.332	Terminal connector for Isolator to receive ACSR conductor suitable for horizontal take off	12.00	Nos
8.333	Terminal connector for LA to receive ACSR conductor suitable for horizontal take off	15.00	Nos
8.334	Terminal connector for CT to receive ACSR conductor suitable for horizontal take off	6.00	Nos
8.335	Terminal connector for CVT to receive ACSR conductor suitable for horizontal take off	6.00	Nos
8.336	Terminal connector for Cable sealing End to receive ACSR conductor suitable for horizontal take off for 220kV GIS End	6.00	Nos
8.337	Terminal connector for SF6 Air bushing to receive ACSR conductor suitable for horizontal take off	15.00	Nos
8.34	Clamps & Connectors etc: 33kV Equipments for ACSR MOOSE.		
8.341	Terminal connector for power transformer to receive ACSR conductor suitable for horizontal take off	3.00	Nos
8.342	Terminal connector for Isolator to receive ACSR conductor suitable for horizontal take off	78.00	Nos
8.343	Terminal connector for LA to receive ACSR conductor suitable for horizontal take off	15.00	Nos
8.344	Terminal connector for CT to receive ACSR conductor suitable for horizontal take off	18.00	Nos
8.345	Terminal connector for CB to receive ACSR conductor suitable for horizontal take off	24.00	Nos
8.346	Terminal connector for PT to receive ACSR conductor suitable for horizontal take off	9.00	Nos
8.347	Terminal connector for station transformer to receive ACSR conductor suitable for horizontal take off	6.00	Nos
8.348	Terminal connector for HG Fuse to receive ACSR conductor suitable for horizontal take off	12.00	Nos
8.349	Spacer for Twin Bus ACSR 33kV Bus	100.00	Nos
9.0	Substation Earthing Systems:		
9.1	Earthing Conductor for Burrial : 75X10mm GI Flat for Earthing conductor for Main Mat and Below Ground Riser	30.10	MT
9.2	Earthing Conductor; 75X10mm GI (HDG) Flat for Raiser from the burial earth mat to outdoor equipments, structure, building lightning protection etc)	5.90	MT
9.3	Earthing Conductor; 50X6mm GI (HDG) Flat for Raiser for Console box, LT Panels, DC Panels, Marshalling boxes etc.	1.08	MT
9.4	Earthing device & Associated Accessories (50 mm heavy duty GI PERFORATED Pipe 3 mtrs long for treated earth pit)	58.00	Nos
9.5	Earthing device & Associated Accessories 40 mm MS rod 3 mtrs long for non-treated earth pit	12.00	Nos
9.6	Earthing Spikes and Its Fittings in all respect.		
9.61	Earthing Spikes of 2 mtr long each GI pipe & other accessories and Its Fittings in all respect. (for 220 & 33kV side column gantry)	3.00	Nos
9.62	Switchyard building lightning protection (all materials & accessories like Shielding Wire, PG clamp, Test link, D shackle etc) as per IS/National Building code standard		
9.621	20x3mm copper Flat for horizontal and down conductor	310.00	Mtrs
9.622	10mm dia 1000mm Long Air Termination Spike	8.00	Nos
9.623	GS Fixing Clamps for 20x3mm Copper Conductor	210.00	Nos
9.624	Test Joint	6.00	Nos
10.0	G.I Cable Trays including support GI angle suitable for different sections along with its accessories as per TS. Details of No. of tiers are indicated in the TS-Civil Section accordingly the requirement can be ascertained & High Quality ISI mark PVC-U selflit Pipe, PVC elbow bend, PVC Tee etc suitable for under ground burrial (Hard Conduit including of adequate tensile strength minimum 7kg/sqmm or better) as per TS.		

10.01	G.I Cable Trays(size: 450x75x2500mm)	138	Mtrs
10.02	G.I Cable Trays(size: 300x75x2500mm)	55	Mtrs
10.03	G.I Cable Trays(size: 150x75x2500mm)	65	Mtrs
10.04	Support G. I angle 50x50x6 mm including 6mm MS plate for cable tray	2.6	MT
10.05	100mm dia PVC Pipe	30	Mtrs
10.06	50mm dia PVC Pipe	20	Mtrs
11.0	Sub Station Switchyard BMK, AC Console & Other MB as per Tech Spec.		
11.01	Switchyard AC Console for Lighting	2.00	Nos
11.02	Switchyard Receptacle Board for TFR Oil Filtration (01 no. near 220/33kV Power transformer)	1.00	Nos
11.03	Switchyard Receptacle Board for Welding & Other Emergency Nature Work	1.00	Nos
11.04	33kV switchyard Bay Marshalling Kiosk	2.00	Nos
12.0	Lighting cum Lightning Mast (Including Foundation bolts) for 220/33kV Class		
12.01	Supply of Lighting cum Lightning Mast including LED lighting fixtures (Excluding 30 Mtr. Monopole) with control gear panel etc suitable for wind zone-V , with all other accessories like motor for hoisting/lowering the lighting platform & other switchgear and lighting control panel etc. for 30 Mtrs. height Monopole (HDG)	2.00	Nos
12.02	30 Mtrs height Monopole (HDG) for Lighting cum Lightning Mast structure suitable for wind zone-V (2 Nos.)	36.00	MT
13.00	General Equipment & Substation Accessories: Supply of Power and control cable including fixing of cable with terminal connections both at equipments and control panels with supply of and fixing of lugs, Ferrules, clamps, connectors, glands, fixing of cable trays, including supply of N&B, Link plates, Cable Markers, Plaster of Paris, M-Seal Compounds etc., for sealing purposes and all necessary arrangements, Supply of Earthing Flats, Earthing, laying of Cable trench slabs and chequered plate etc., for the cable trench, Cable scheduled and cable diagram to be prepared by the Contractor.		
13.10	Power Cables, 1.1kV, XLPE & PVC Armoured, Aluminium Conductor (As per Specification) including power cable termination, Lugs, Glands & other materials in order to complete the activity.		
13.11	3.5CX185 mm ² XLPE	180	Mtrs
13.12	3.5CX120 mm ² XLPE	100	Mtrs
13.13	3.5CX70 mm ² PVC	260	Mtrs
13.14	3.5CX35 mm ² PVC	300	Mtrs
13.15	4CX 16 mm ² PVC	884	Mtrs
13.16	4CX 6 mm ² PVC	300	Mtrs
13.17	2CX 6 mm ² PVC	1569	Mtrs
13.20	Control Cables, 1.1kV, PVC Armoured Stranded Copper (As per specification) including control cable termination, Lugs, Glands & other materials in order to complete the activity.		
13.21	5CX 2.5 mm ²	6078	Mtrs
13.22	10CX 2.5 mm ²	1682	Mtrs
13.23	12CX 2.5 mm ²	3722	Mtrs
13.24	16CX 2.5 mm ²	1180	Mtrs
13.25	19CX 2.5 mm ²	2130	Mtrs
13.26	1CX 120 mm ² Bat to Bat Charger & Charger to DCDB	90	Mtrs
14.0	SUPPLY OF STATION TRANSFORMER& OTHER MATERIALS FOR MEETING THE AUXILIARY SUPPLY OF THE SUBSTATION AS PER TECHNICAL SPECIFICATION		
14.01	STATION TRANSFORMER 33KV/0.43 KV,250 KVA (AS PER SPECIFICATION)	2	Nos
15.0	SUB STATION LIGHTING (AS PER SPECIFICATION AND APPROVED DRAWINGS)(includes switchyard street area)		
15.10	Indoor Lighting:		
15.101	220kV GIS Building Indoor Lighting, it includes supply of fixtures & lamps (LED) of OPTCL approved Make with switchgear, Conduit & other required materials for succesful illumination of the area/rooms. (No. of LED Lighting fixtures are to be calculated based on the illumination design considering the required lux level indicated in the technical spec & fixing of the same rigidly on the suitable height either ceiling & wall as required.) (i) 150W High bay LED of OPTCL approved make	1	LOT
15.102	Control room building indoor Lighting, it includes supply of fixtures & lamps (LED) of OPTCL approved make with switch gear, Conduit & other required materials for succesful illumination of the area/rooms.(No. of LED Lighting fixtures are to be calculated based on the illumination design considering the required lux level indicated in the technical spec & fixing of the same rigidly on the suitable height either ceiling & wall as required.) (i) Surface Mounted LED 42W of OPTCL approved make (ii) 34W LED Lights of OPTCL approved make (for control room) (iii)36W LED Corrossion Proof Luminaire with IP65 Protection suitable for dusty & Corrossive atmosphere of OPTCL approved make for battery room.	1	LOT
15.103	Indoor Lighting OF Security Shed cum Visitors room, FFPH Building, Store Shed, Parking shed: It includes supply of fixtures & lamps (LED) of OPTCL approved make with switch gear,Conduit & other required materials for succesful illumination of the area/rooms. (No. of LED Lighting fixtures are to be calculated based on the illumination design considering the required lux level indicated in the technical spec & fixing of the same rigidly on the suitable height either ceiling & wall as required.) (i) 34W LED Lights of OPTCL approved make (for control room)	1	LOT
15.20	Outdoor Lighting:		
15.201	Sub-Station Switchyard Lighting, it includes Supply of fixtures & lamps (LED) of OPTCL approved Make with switchgear,GI Conduit etc.(Lighting fixtures are to be fixed rigidly on the Column at a suitable height so that the required lux can be achieved).(150 watt each)	12	Nos
15.202	Street Lighting: GI Tubular Pole: (410-SP-24: IS 2713-Part-II-1980 or latest) Length of pole 8.5 mtrs(minimum weight 158 Kgs). & LED light fittings etc. (All the Street Light Pole Shall be of GI Tubular Pole and provision of a GI Junction box with Suitable Covers at a height of 1 Metre from the Ground. The Junction Box shall have Provision of Fuses, Buses, Connectors for cable in and out. (It Includes Supply of LED Lighting Fixtures with Lamps of 100Watts of OPTCL approved make & as per technical specification).	18	Nos

15.203	Outdoor Kiosk for Street Lighting Purpose having 2 Nos. 200Amp Switch Fuse Units and , 6 Nos. outlets of 32Amp MCB For Street Lighting. (Suitable For XLPE Cables (3.5C X 120Sqmm) from Main ACDB from Control Room to the Outdoor Kiosk. XLPE Cable Of 4C X 16Sqmm from Outdoor Kiosk to the Street Light Poles and 4C X 6Sq.mm from Pole to Pole and 2C X 6Sq.mm from Pole to Lighting Fixtures. 1 No. Outdoor Kiosk for Colony Supply Purpose (* Remarks: For Supply of All the Cables As Indicated Are Covered In the Cable Items As Indicated Above)	1	Nos
16.0	Outdoor Kiosk for Street Lighting Purpose having 2 Nos. 200Amp Switch Fuse Units and , 6 Nos. outlets of 32Amp MCB For Street Lighting. (Suitable For XLPE Cables (3.5C X 120Sqmm) from Main ACDB from Control Room to the Outdoor Kiosk. XLPE Cable Of 4C X 16Sqmm from Outdoor Kiosk to the Street Light Poles and 4C X 6Sq.mm from Pole to Pole and 2C X 6Sq.mm from Pole to Lighting Fixtures. 1 No. Outdoor Kiosk for Colony Supply Purpose (* Remarks: For Supply of All the Cables As Indicated Are Covered In the Cable Items As Indicated Above)	12	Nos
17.0	220kV GIS hall-ventilation system through ducting (Pressurization type ventilation system) at AHU room as per technical specification	1	LS
18.0	Fire Fighting System (Portable /Trolley/ Wheel Mounted Fire Extinguishers sets for Control Room, Equipment like Transformer and other areas as per Tech Spec.		
18.01	Foam Type-9 Ltrs	4	Nos
18.02	Dry Chemical Powder (Trolley Mounted)- 22.5Kgs	4	Nos
18.03	Dry Powder Type - 5Kgs	4	Nos
18.04	Co ₂ - 4.5Kgs	10	Nos
18.05	CO ₂ - 9Kgs	10	Nos
18.06	CO ₂ (Trolley Mounted)- 22.5Kgs	4	Nos
18.07	Fire Bucket (6 Nos in each stand) with stand	5	Sets
18.08	9 litre water type	4	Nos
18.09	4.5 kg DCP type	4	Nos
18.10	50 Litres Mechanical Foam type	2	Nos
18.11	Supply of Smoke & Heat detection system: Addressable optical Smoke & Heat Multi detector(50 Nos) for main control room building including all accessories, Main control panel(Microprocessor based 2 loop fire alarm control panel expandable upto 18 loops fully networkable with each loop capable of taking 99 devices, 8 line x 40 character alpha- numeric liquid crystal display .The panel shall be soft addressable type . The panel shall be able to give pin point location of all fire/fault conditions. Further, the panel must be able to automatically switch off respective control switches when ever any alarm is triggered. The panel shall have in built rectifier, Loop cards,provision for external & internal printer(if required), L C D unit to indicate Fire/Fault Signal with address and analog output, built in printer to log all fire or fault events complete in all respects, integral SMF lead acid batteries with sealed cells of 24 V capable of running for a minimum of 8 hours with integral battery charger complete as required and as per specification. The fire alarm panel shall be suitable for software integration with BMS & PA system ,wall mounting loop powered addressable type hooter with all accessories , addressable manual call box made of polycarbonate with plastic break glass front and complete with monitor module MCB, addressable isolator module with required PVC box, fittings and fixtures, wiring with PVC FRLS wire to cover the required for fire & smoke detection etc. (One control room building & 1 no. GIS hall are to be provided with Heat & smoke detection). Should have facility for integration with SAS.	1	Sets
19.0	Fire Fighting (HVW system & hydrant system) system with Detailed Design Suitable for 20MVA, 220/33kV Power Transformer etc., as per the Latest Standard & TS.		
19.01	Fire Fighting Equipment: (Main Pump, Jockey Pump, DG Set cum Pump, Control Panel for Fire Fighting System (HIGH PRESSURE : Hydrant and Mulsifire system) to take care of 1 No. 20 MVA, 220/33 KV POWER TRANSFORMER , switcyard equipment and buildings. HVW system & hydrant sytsem, complete with all piping, valves, fittings etc inside pump house for Fire protection sytem of substation) as per the technical spec & Latest standard.	1	Lot
19.02	Hydrant pipe for Substation fire protection system	0.08	km
19.03	Hydrant sytsem, complete U/G piping of different sizes,valves and accessories etc outside the Pump House for Fire protection sytem of 1 Nos. 20 MVA, 220/33 KV POWER TRANSFORMER , switcyard equipment and buildings as per the technical spec & Latest standard.	1	Lot
19.04	HVW Spray sytsem, Hydrant System and complete U/G and O/G piping,different type of valves,Fire sensor etc and accessories etc near the Transformer for Fire protection of 1 No. 20 MVA, 220/33 KV POWER TRANSFORMER , as per the technical spec.	1	Lot
20.0	Substation Automation System for 220/33kv Substation on Parallel redundancy protocol(PRP) mode: Design, Engineering, Drawing, Supervision, Installation, Testing & Commissioning of Substation Automation System along with Supply of the following 220 And 33kv level of Protection Panels consisting of Bay Control Units & Numerical Protection Relays and other Auxiliary Relays Suitable for SAS as Per Technical Specification. NOTE: All Protective Relays & BCU Shall Be Numerical Type.		
20.01	Gate way panel for Sub-Station Automation (in PRP as per the specification & indicative drg) system (for All 220 & 33 KV side bays including the future bays),other accessories (comprising servers, engg. Station, works station (Main & standby), Remote station control, Colour Laser jet Printers & dot matrix printer for local station as per requirement and also for remote station, Ethernet Switches , LIU, Red Box, Multimode glass fibre Double jacket armoured optical cables, special cables like F.O patch cord & armoured FO cables of adequate length etc required for the system in all respect as per latest IEC 61850 standard, Inverters of required capacity & rating (Input shall be both A.C & D.C and output shall be A.C) etc as per TS. A large vedio screen of 60 inches for display including all type of accessories & as per technical specification.	1.00	Sets
20.02	BCU for Substation Auxilliary System (Station AC, Station DC, Lighting, Fire fighting, Diesel generator etc. as per the site requirement)	1.00	Sets
20.3	220 KV PROTECTION PANELS		
20.31	Feeder Protection panel (Main-I , Main-II & Back-up protection with auto reclosure Distance Protection) with Bay control unit (BCU) for substation automation system. (Simplex with front Glass door)	4	Sets

20.32	Transformer Protection Panel (Differential I & II , REF I & II & Back-up Protection for HV & LV side Considering HV & LV side of 220/33kV, 20MVA) with Bay control units (BCU) for HV & LV for substation automation system. (Simplex with front Glass door)	1	Sets
20.33	Bus Coupler Protection Panel with Bay control unit (BCU) for substation automation system. (Simplex with front Glass door)	1	Nos
20.34	Bus-Bar Protection Panel (Provision of bus bar modules for the future bays and to be integrated with the Automation system) (Simplex with front Glass door).	1	Sets
20.35	Main 1 and Main 2 Distance and Line Differential Protection with all necessary modifications for two lines.(OPTCL's remote End Stations)	2	Sets
20.4	33 KV PROTECTION PANELS		
20.41	33kV Feeder Protection Panel with Bay control Protection unit (BCPU) for substation automation system	2	Nos
20.42	33kV Transformer Protection Panel with Bay control Protection unit (BCPU) for substation automation system (33kV side of 220/33kV, 20MVA)	1	Nos
20.43	33kV Transfer Bus Coupler Protection Panel with Bay control Protection unit(BCPU) for substation automation system.	1	Nos
21.0	AC & DC SYSTEM		
21.1	AC SYSTEM		
21.11	Main ACDB, Facilities for integration with SAS as per the site requirement, as per specification	1.00	Sets
21.12	ACDB as per Technical Specification.	1.00	Sets
21.13	Main Lighting Distribution Board as per Technical Specification	1.00	Sets
21.14	Indoor Lighting Distribution board as per Technical Specification	1.00	Sets
21.15	Emergency Lighting Distribution Board	1.00	Sets
21.16	Indoor Receptacle Board	2.00	Sets
21.17	2 TR Capacity Split Air Conditioning Units (Inverter type latest model) of OPTCL approved make.	12	Nos
21.2	220V & 48V DC System:		
21.21	220V DC BOARD (Having 100A DC MCCB as Incomer , E/F (Earth Leakage), Under & Over Voltage as per Specification (DCDB-1,DCDB-2 & B/C). Consider Separate Source (DC1 & DC 2) to each panels & accordingly sufficient Nos. of DC output from DB-1 & 2 to be considered. Facilities for integration with SAS as per the site requirement.	1	Sets
21.22	220V DC Emergency Distribution Board	1	Sets
21.23	Battery (350AH PLANTE type) for 220V DC	2	Sets
21.24	Battery Charger for 350AH, 220V DC (Float & Float cum Boost) (including provision of series dropper diodes with heat sinks & other protection facility at the DC Load terminal end in order to feed 220V to the load).Facilities for integration with SAS as per the site requirement.	2	Sets
21.25	DE MINERALISED PLANT of 30 L/Hr for making Distilled water for battery banks	1	Sets
21.26	48V DC BOARD (Having 75A DC MCCB as Incomer , E/F (Earth Leakage), Under & Over Voltage as per Specification (DCDB-1,DCDB-2 & B/C). Consider Seprate source (DC1 & DC2) to each panels & accordingly sufficient Nos. of DC output from DB-1 & DB-2 to be considered. Facilities for integration with SAS as per the site requirement.	1	Sets
21.27	48V, 300 AH, VRLA type battery set	2	Sets
21.28	SMPS based battery charger for 48V, 75A float cum boost (as recommended by the Battery manufacturer)	2	Nos
22.0	Accessories for FOTE / OPGW System as per technical specification:		
22.01	24 Fibre (DWSM) OPGW fibre optic cable	0.1	Km
22.02	OPGW hardware set like suspension assembly, Tension Assembly (Dead end assembly, pass through assembly), vibration damper, down lead assemblies for 24/48 fibre (DWSM) OPGW, Joint box	1	Km
22.03	Optical line terminal equipment (OLTE)-STM4 type SDH equipment with integrated MUX & tributary cards for speech & data ports for interfacing of speech & data which should be compatible with existing OPTCL system.	1	Nos
22.04	Supply of FODP (Fibre optic Distribution panel) 48 F: Indoor type, rack mounted with FCPC coupling and pigtails (DWSM fibre)	1	Nos
22.05	Digital tele-protection coupler compatible for interfacing with SDHMUX	1	Nos
22.06	Earth flat, cable tray, telephone cable, ACDB, DCDB, foundation rail, Junction Box, Cat 5 cable & Misc items	1	Lot
23.00	EOT Crane for GIS building for 220kV GIS station (5T Capacity safe working load & minimum height of crane have shall be 8.0 meters or as per actual requirement whichever is higher. The crane shall have minimum speeds under full load of: Speed (a) Hoisting 2 meters/minute (b) Cross Travel 10 meters/minute (c) Long Travel 20 meters/minute (d) Creep speed shall be of 25% of operating speed.The crane shall be possible to be operated through the cable, through the pendant control and which shall be easily accessible from the floor of GIS building and through remote control device.) including all accessories with control panel.	1	Nos
24.0	MANDATORY SPARE: Being Quoted Separatly as listed from 117 of this BOQ		
25.00	GENERAL TOOLS & TACKLES - As per Annexure A of Part-36 of Technical Specifications	1	Lot
26.00	MAINTENANCE TESTING EQUIPMENTS - As per Annexure B of Part-36 of Technical Specifications	1	Lot
27.00	OFFICE FURNITURE - As per Annexure C of Part-36 of Technical Specifications	1	Lot
28.00	Best Quality & approved make Insulating Mat (Confirming to IS:15652:2006) to be kept infront of all Panels, Boards etc., (2000X1000X3)mm Size	40	Nos
29.0	DIFFERENT TYPE OF LATICE TYPE COLUMNS WITH DETAILS & DIFFERENT TYPE OF BEAMS WITH DETAILS		
29.01	(Tower) 220kV COLUMN: P1S TYPE,- HEIGHT-21.5 MTRS	14	MT
29.02	(Girder) 220kV BEAM:Q1 TYPE,-LENGTH-18 MTRS	3	MT
29.03	(Tower) 33kV COLUMN, HEIGHT-8 MTRS	9.7	MT
29.04	(Girder) 33kV BEAM:G1 TYPE,-LENGTH-5.5 MTRS	4.15	MT
30.0	SUPPORT STRUCTURES FOR OUDOOR EQUIPMENTS		
30.1	SUPPORT STRUCTURES FOR 220kV EQUIPMENT		
30.11	220kV Isolator	7	MT

30.12	220kV Surge Arrester	4	MT
30.13	220kV Current transformer	1.5	MT
30.14	220kV Potential transformer	1.2	MT
30.15	220kV Cable sealing end	1.5	MT
30.16	SF6 Bushing	4.5	MT
30.20	SUPPORT STRUCTURES FOR 33kV EQUIPMENT		
30.201	33 KV Lightning Arrestor	0.7	MT
30.202	33 KV Current Transformer	1.5	MT
30.203	33 KV Bus Potential Transformer	0.3	MT
30.204	33 KV Metering Current Transformer	0.6	MT
30.205	33 KV Metering VoltageTransformer	0.6	MT
30.206	33 KV Bus Post Insulator	3	MT
30.207	33 KV Horn Gap Fuse	0.64	MT
30.208	33 KV Isolator	2.32	MT
30.209	33 KV Isolator with ES	1.6	MT
30.3	Cable End Termination	0.8	MT
30.4	GI bolts ,Nuts, washers plain & spring etc for the above structures	2.18	MT
30.5	GI Foundation bolts & nuts with plate & other washers as required	3.95	MT
30.6	Triple Pole Structure for Double circuit 33kV Line: 3 Nos. Galvanized H-Type 14 Mtr. Structure including Channels, Angles and Flat for Belting, Bracing, mounting and termination of 6 Nos. 33kV Single core cable. This also includes supply of Lightning Arrestors, GO AB Switch, Polymer Pin & Disc Insulators incl. Hardware fittings, Complete Stay Ser, Earthing arrangement, HDPE Pipes from Ground Level to a Suitable Height on the Pole etc. to terminate the 33kV Cable on the structure complete. Note: Stringing of 148 Sq.mm. AAA Conductor from this Gantry to TFL Pump House is not included in above.	1	Lot
31.0	220kV XLPE Cable Package (220kV GIS station to MRSS station):		
31.01	24 Fibre (DWDM) OPGW fibre optic cable	1.61	Km
31.02	installation hardware for 24 fibre optic cable	1	Lot
31.03	50mm DIA PVC PIPE / 40mm DIA PLB DUCT (OPTICAL FIBER CABLE)	1.61	Km
31.04	Supply of 220kV XLPE cable straight through joint kit complete suitable for cable 220kV 1C 1000 Sq. Mm Cu XLPE Cable	6	Nos
31.05	Supply of Cross bonding & Link Boxes for Earthing	2	Nos
32.00	SCHEDULE-2B-SS (Erection)		
33.00	220/33kV, 20MVA, YNyn0, 3 phase Power Transformer Complete in all respect.	1.00	Nos
33.01	Short Circuit Testing of 220/33kV, 20MVA, YNyn0, 3 phase Power Transformer at any Govt. Lab in India	1.00	LS
34.00	245kV GIS EQUIPMENT as per latest IEC standard & type tested equipment as per technical specification, with open future proof & flexible system in line with IEC 61850 & IEC 62271-203. (Circuit breaker shall be C2 - M2 class as per IEC 62271-100).		
34.01	245kV, 3150A, 50kA (3 sec for CB & 1 sec for Disconnecter, Grounding switch, CT, PT), SF6 gas insulated Transformer feeder bay module each comprising of SF6 gas insulated circuit breaker, current transformer, bus-bar dis connectors with common grounding switch, Motorised dis connectors with safety grounding switch(es), high speed fault making motorised grounding switch, Stand alone Local control cubicle, SF6 gas monitoring system for complete bay, SF6 bus duct termination arrangement, PD sensor (adequate number of UHF sensors in the offered GIS equipment for detection of Partial discharge (of 5 pC and above) as per IEC 60270 through Partial Discharge (PD) monitoring system), different gas compartment, O- ring & gaskets, Nuts, Bolts & Washers Absorbent, Limit Switch ,SF6 Gas , etc to complete Transformer feeder bay module & its earthing arrangement with earthing strips of adequate size as per the technical specification.	1.00	Sets
34.02	245kV, 3150A, 50kA (3 sec for CB & 1 sec for Disconnecter, Grounding switch, CT & PT), SF6 gas insulated Line feeder bay module each comprising of SF6 gas insulated circuit breaker, current transformer, Line Potential Transformer (3 core), bus-bar dis connectors with common grounding switch, Motorised dis connectors with safety grounding switch(es), high speed fault making motorised grounding switch, Stand alone Local control cubicle, SF6 gas monitoring system for complete bay, SF6 bus duct termination arrangement, PD sensor (adequate number of UHF sensors in the offered GIS equipment for detection of Partial discharge (of 5 pC and above) as per IEC 60270 through Partial Discharge (PD) monitoring system), different gas compartment, O- ring & gaskets, Nuts, Bolts & Washers Absorbent, Limit Switch ,SF6 Gas , etc to complete line feeder bay module & its earthing arrangement with earthing strips of adequate size as per the technical specification.	4.00	Sets
34.03	245kV , 3150A, 50 kA (3 sec for Bus bar , 1 sec for disconnecter, grounding switch & bus P.T), 3- phase Isolated , SF6 gas insulated , Metal enclosed bus bars each enclosed in bus enclosures running along the length of the switchgear to interconnect each of circuit breaker bay module. Each bus bar set shall be complete with bus potential transformer (3 core), dis connectors , bus bar grounding switch, SF6 gas monitoring system PD sensor (adequate number of UHF sensors in the offered GIS equipment for detection of Partial discharge (of 5 pC and above) as per IEC 60270 through Partial Discharge (PD) monitoring system), different gas compartment, O- ring & gaskets, Nuts, Bolts & Washers Absorbent, Limit Switch ,SF6 Gas , etc to complete the bus & its earthing arrangement with earthing strips of adequate size (as per IEEE-80-2000 and CIGRE44 to protect operating staff against any hazardous touch voltages and electro-magnetic interferences) as per the technical specification.	2.00	Sets
34.04	SF6 gas insulated Bus Coupler Bay Module comprising of SF6 gas insulated circuit breaker, current transformer, dis connectors switches, disconnecter with safety grounding switch(es). Local control cubicle, SF6 gas monitoring system, PD sensor (adequate number of UHF sensors in the offered GIS equipment for detection of Partial discharge (of 5 pC and above) as per IEC 60270 through Partial Discharge (PD) monitoring system), different gas compartment, O- ring & gaskets, Nuts, Bolts & Washers Absorbent, Limit Switch ,SF6 Gas , etc to complete Bus Coupler bay module & its earthing arrangement with earthing strips of adequate size (as per IEEE-80-2000 and CIGRE44 to protect operating staff against any hazardous touch voltages and electro-magnetic interferences) as per the technical specification.	1.00	Sets

34.05	245kV, 3150A, 50kA, 3 sec, single phase, SF6 gas Insulated Bus Duct outside GIS Hall alongwith associated Support structure arrangement bends, joints,accessories, & its earthing arrangement with earthing strips of adequate size (as per IEEE-80-2000 and CIGRE44 to protect operating staff against any hazardous touch voltages and electro-magnetic interferences) as per the technical specification etc.	480.00	RM
34.06	245kV, 3150A, 50kA SF6/Air Bushing (Bushing shall be of Polymer / composite insulator type and shall be seamless sheath of a silicone rubber compound. The hollow silicone composite insulators shall comply as per IEC 61462 and the relevant parts of IEC 62217. The design of the composite insulators shall be tested and verified according to IEC 61462) For Connecting GIS to AIS.	15.00	Nos
34.07	Portable Partial Discharge(PD) monitoring system: 245kV system shall have Portable Partial Discharge(PD) monitoring system & shall be capable for measuring PD in charged GIS environment ,bandwidth in order of 100 MHz–2GHz & provision to select a wide range of intermediate bandwidths and the principle of operation shall be based on UHF principle of detection. The Detection and measurement of PD and bouncing particles having in built large coloured LCD for displaying and storing facility in the instrument for further analysis to locate actual source of PD such as free conducting particles, floating components, voids in spacers, particle on spacer surfaces etc.	1.00	Sets
35.00	250kVA , 380BHP, 220kW, Silent AMF Diesel Generator set, 1500 rpm with AMF control panel as per Technical Specification.	1.00	Sets
36.00	220kV OUTDOOR EQUIPMENTS:		
36.01	245kV,50kA/1Sec, 1 Core, CL-0.2, 50VA Single Phase Potential Transformer (AIS) for Metering	6.00	Nos
36.02	PT Console Box for above PTs	2.00	Nos
36.03	245kV,50kA/1Sec, 5 Core, 1200-600-300/1A, CL-PX,0.2S, 30VA Single Phase Current Transformer (AIS) for Metering	6.00	Nos
36.04	CT Console Box for above CTs	2.00	Nos
36.05	245kV,3150A,50kA/1sec, Double Break Isolator (Isolator with earth switch including post insulators for incomer)	2.00	Sets
36.06	220kV, Cable Sealing End (220kV GIS END)	6.00	Nos
36.07	220kV, Cable GIS end termination kit at (MRSS Substation End)	6.00	Nos
36.08	216kV Metal Oxide Surge Arrestor, 10kA, Long duration discharge class III, 10kJ/kV at 216kV as per technical Specification	15.00	Nos
37.0	33kV OUTDOOR EQUIPMENTS:		
37.01	33kV, 1250A, 31.5kA/3s, 3 Phase, Outdoor Vaccum Circuit breaker with Supporting Structure	4.00	Nos
37.02	33kV Single Phase Current Transformer for 20MVA Power transformer, 5 core, ratio: 800-400-200/1A	3.00	Nos
37.03	CT Console Box for above CTs	1.00	Nos
37.04	33kV Single Phase Current Transformer for 33kV Feeder & 33kV Buscoupler, 3 core, ratio: 800-400-200/1A	9.00	Nos
37.05	CT Console Box for above CTs	3.00	Nos
37.06	33kV Single Phase, Bus Potential Transformer, 2 core (0.2,3P classes), 33kV/110V/110V	3.00	Nos
37.07	PT Console Box for above PTs	1.00	Nos
37.08	33kV Single Phase, Metering Current Transformers for 33kV feeder bays, 1 core, 800-400-200/1A	6.00	Nos
37.09	CT Console Box for above CTs	2.00	Nos
37.10	33kV Single Phase, Metering Potential Transformers for 33kV feeder bays, 1 core, 33kV/110V	6.00	Nos
37.11	PT Console Box for above PTs	2.00	Nos
37.12	33kV, 1250A, 31.5kA/1s, Outdoor Isolator W/O Earth Switch	8.00	Sets
37.13	33kV, 1250A, 31.5kA/1s, Outdoor Isolator with Earth Switch	5.00	Sets
37.14	33kv, 200A, Horn Gap fuses	2.00	Sets
37.15	30kV Metal Oxide Surge Arrestor, 10kA, Long duration discharge class III as per technical Specification.	15.00	Nos
37.16	33kV Bus Post Insulator	10.00	Nos.
38.00	Tariff Meter for Main & Check meter for Metering	8.00	Nos
39.00	XLPE Power Copper conductor cable for the GIS system (36kV class) and cable termination kit		
39.01	36kV XLPE Cable 300 sq. mm Copper Single Core (from 33kV side TFL feeder End termination to 33kV Double pole structure having each phase one run)	0.85	Km
39.02	36kV Outdoor type termination Kits (from TFL feeder to 33kV Double pole structure) suitable for 1CX300 Sq.mm	12.00	Nos
40.00	BUS BAR & CIRCUIT MATERIALS		
40.10	Long Rod Silicon Composite Insulator		
40.101	160kN Long rod Insulator strings for 245kV tension purpose	6.00	Sets
40.102	160kN Long rod Insulator strings for 245kV Suspension purpose	6.00	Sets
40.103	120kN Long rod Insulator strings for 33kV tension purpose	36.00	Sets
40.104	90kN Long rod Insulator strings for 33kV Suspension purpose	30.00	Sets
40.20	Single ACSR Moose Conductor:	0.95	Km
40.30	HARDWARES & FITTINGS/SPACERS/CLAMP & CONNECTORS		
40.31	220kV Single Tension H/W fitting for single moose ACSR	6.00	Nos
40.32	220kV Single Suspension H/W fitting for single moose ACSR	6.00	Nos
40.33	Clamps & Connectors etc: 220kV T- clamp for ACSR ZEBRA to ACSR MOOSE drop,220kV Isolator pad clamp suitable for ACSR Moose conductor,3 bolted PG clamp suitable for ACSR Moose conductor,220kV LA Clamp suitable for ACSR Moose, 30kV LA Clamp suitable for ACSR Moose. etc as required.		
40.331	Terminal connector for power transformer to receive ACSR conductor suitable for horizontal take off	3.00	Nos
40.332	Terminal connector for Isolator to receive ACSR conductor suitable for horizontal take off	12.00	Nos
40.333	Terminal connector for LA to receive ACSR conductor suitable for horizontal take off	15.00	Nos
40.334	Terminal connector for CT to receive ACSR conductor suitable for horizontal take off	6.00	Nos
40.335	Terminal connector for PT to receive ACSR conductor suitable for horizontal take off	6.00	Nos
40.336	Terminal connector for Cable sealing End to receive ACSR conductor suitable for horizontal take off for 220kV GIS End	6.00	Nos
40.337	Terminal connector for SF6 Air bushing to receive ACSR conductor suitable for horizontal take off	15.00	Nos
40.34	Clamps & Connectors etc: 33kV Equipments for ACSR MOOSE.		
40.341	Terminal connector for power transformer to receive ACSR conductor suitable for horizontal take off	3.00	Nos
40.342	Terminal connector for Isolator to receive ACSR conductor suitable for horizontal take off	78.00	Nos

40.343	Terminal connector for LA to receive ACSR conductor suitable for horizontal take off	15.00	Nos
40.344	Terminal connector for CT to receive ACSR conductor suitable for horizontal take off	18.00	Nos
40.345	Terminal connector for CB to receive ACSR conductor suitable for horizontal take off	24.00	Nos
40.346	Terminal connector for PT to receive ACSR conductor suitable for horizontal take off	9.00	Nos
40.347	Terminal connector for station transformer to receive ACSR conductor suitable for horizontal take off	6.00	Nos
40.348	Terminal connector for HG Fuse to receive ACSR conductor suitable for horizontal take off	12.00	Nos
40.349	Spacer for Twin Bus ACSR 33kV Bus	100.00	Nos
41.0	Substation Earthing Systems:		
41.1	Earthing Conductor for Burrial : 75X10mm GI Flat for Earthing conductor for Main Mat and Below Ground Riser	5100.00	Mtrs
41.2	Earthing Conductor; 75X10mm GI (HDG) Flat for Raiser from the burial earth mat to outdoor equipments, structure, building lightning protection etc)	1000.00	Mtrs
41.3	Earthing Conductor; 50X6mm GI (HDG) Flat for Raiser for Console box, LT Panels, DC Panels, Marshalling boxes etc., (450 Mtrs.)	450.00	Mtrs
41.4	Earthing device & Associated Accessories (50 mm heavy duty GI PERFORATED Pipe 3 mtrs long for treated earth pit)	58.00	Nos
41.5	Earthing device & Associated Accessories 40 mm MS rod 3 mtrs long for non-treated earth pit	12.00	Nos
41.6	Earthing Spikes and Its Fittings in all respect.		
41.61	Earthing Spikes of 2 mtr long each GI pipe & other accessories and Its Fittings in all respect. (for 220 & 33kV side column gantry)	3	Nos.
41.62	Switchyard building lightning protection (all materials & accessories like Shielding Wire, PG clamp, Test link, D shackle etc) as per IS/National Building code standard		
41.621	20x3mm copper Flat for horizontal and down conductor	310.00	Mtrs
41.622	10mm dia 1000mm Long Air Termination Spike	8.00	Nos
41.623	GS Fixing Clamps for 20x3mm Copper Conductor	210.00	Nos
41.624	Test Joint	6.00	Nos
42.00	G.I Cable Trays including support GI angle suitable for different sections along with its accessories as per TS. Details of No. of tiers are indicated in the TS-Civil Section accordingly the requirement can be ascertained & High Quality ISI mark PVC-U selfit Pipe, PVC elbow bend, PVC Tee etc suitable for under ground burrial (Hard Conduit Including of adequate tensile strength minimum 7kg/sqmm or better) as per TS.		
42.01	G.I Cable Trays(size: 450x75x2500mm)	138	Mtrs
42.02	G.I Cable Trays(size: 300x75x2500mm)	55	Mtrs
42.03	G.I Cable Trays(size: 150x75x2500mm)	65	Mtrs
42.04	Support G. I angle 50x50x6 mm including 6mm MS plate for cable tray	2.6	MT
42.05	100mm dia PVC Pipe	30	Mtrs
42.06	50mm dia PVC Pipe	20	Mtrs
43.00	Sub Station Switchyard BMK, AC Console & Other MB as per Tech Spec.		
43.01	Switchyard AC Console for Lighting	2.00	Nos
43.02	Switchyard Receptacle Board for TFR Oil Filtration (01 no. near 220/33kV Power transformer)	1.00	Nos
43.03	Switchyard Receptacle Board for Welding & Other Emergency Nature Work	1.00	Nos
43.04	33kV switchyard Bay Marshalling Kiosk	2.00	Nos
44.00	Lighting cum Lightning Mast (Including Foundation bolts) for 220/33kV Class		
44.01	Fixing of Lighting cum Lightning arrangement including LED lighting fixtures (excluding 30 Meter Monopole) with control gear panel etc suitable for wind zone-V , with all other accessories like motor for hoisting/lowering the lighting platform & other switchgear and lighting control panel etc.	2.00	Nos
44.02	Erection of 30 Mtrs height Monopole (HDG) Lighting cum Lightning Mast structure suitable for wind zone-V	2.00	Nos
45.00	General Equipment & Substation Accessories: Supply of Power and control cable including fixing of cable with terminal connections both at equipments and control panels with supply of and fixing of lugs, Ferrules, clamps, connectors, glands, fixing of cable trays, including supply of N&B, Link plates, Cable Markers, Plaster of Paris, M-Seal Compounds etc., for sealing purposes and all necessary arrangements, Supply of Earthing Flats, Earthing, laying of Cable trench slabs and chequered plate etc., for the cable trench, Cable scheduled and cable diagram to be prepared by the Contractor.		
45.10	Power Cables, 1.1kV, XLPE & PVC Armoured, Aluminium Conductor (As per Specification) including power cable termination, Lugs, Glands & other materials in order to complete the activity.		
45.101	3.5CX185 mm ² XLPE	180	Mtrs
45.102	3.5CX120 mm ² XLPE	100	Mtrs
45.103	3.5CX70 mm ² PVC	260	Mtrs
45.104	3.5CX35 mm ² PVC	300	Mtrs
45.105	4CX 16 mm ² PVC	884	Mtrs
45.106	4CX 6 mm ² PVC	300	Mtrs
45.107	2CX 6 mm ² PVC	1569	Mtrs
45.20	Control Cables, 1.1kV, PVC Armoured Stranded Copper (As per specification) including control cable termination, Lugs, Glands & other materials in order to complete the activity.		
45.201	5CX 2.5 mm ²	6078	Mtrs
45.202	10CX 2.5 mm ²	1682	Mtrs
45.203	12CX 2.5 mm ²	3722	Mtrs
45.204	16CX 2.5 mm ²	1180	Mtrs
45.205	19CX 2.5 mm ²	2130	Mtrs
45.206	1CX 120 mm ² Bat to Bat Charger & Charger to DCDB	90	Mtrs
46.00	Station Transformer & Other Materials for Meeting the Auxilliary Supply of the Substation As Per Technical Specification		
46.01	STATION TRANSFORMER 33KV/0.43 KV,250 KVA (AS PER SPECIFICATION)	2.00	Nos
47.00	SUB STATION LIGHTING (AS PER TECHNICAL SPECIFICATION)		
47.10	Indoor Lighting:		

47.101	220kV GIS Building Indoor Lighting, it includes fixtures & lamps (LED) of OPTCL approved Make with switchgear, Conduit & other required materials for succesful illumination of the area/rooms. (No. of LED Lighting fixtures are to be calculated based on the illumination design considering the required lux level indicated in the technical spec & fixing of the same rigidly on the suitable height either ceiling & wall as required.) (i) 150W High bay LED of OPTCL approved make	1	LOT
47.102	Control room building indoor Lighting, it includes fixtures & lamps (LED) of OPTCL approved make with switch gear, Conduit & other required materials for succesful illumination of the area/rooms.(No. of LED Lighting fixtures are to be calculated based on the illumination design considering the required lux level indicated in the technical spec & fixing of the same rigidly on the suitable height either ceiling & wall as required.) (i) Surface Mounted LED 42W of OPTCL approved make (ii) 34W LED Lights of OPTCL approved make (for control room) (iii)36W LED Corrossion Proof Luminaire with IP65 Protection suitable for dusty & Corrossive atmosphere of OPTCL approved make for battery room.	1	LOT
47.103	Indoor Lighting OF Security Shed cum Visitors room, FFFPH Building, Store Shed, Parking shed: It includes fixtures & lamps (LED) of OPTCL approved make with switch gear,Conduit & other required materials for succesful illumination of the area/rooms. (No. of LED Lighting fixtures are to be calculated based on the illumination design considering the required lux level indicated in the technical spec & fixing of the same rigidly on the suitable height either ceiling & wall as required.) (i) 34W LED Lights of OPTCL approved make (for control room)	1	LOT
47.20	Outdoor Lighting:		
47.201	Sub-Station Switchyard Lighting, it includes fixtures & lamps (LED) of OPTCL approved Make with switchgear, GI Conduit etc.(Lighting fixtures are to be fixed rigidly on the Column at a suitable height so that the required lux can be achieved).(150 watt each)	12	Nos
47.202	Street Lighting: GI Tubular Pole: (410-SP-24: IS 2713-Part-II-1980 or latest) Length of pole 8.5 mtrs(minimum weight 158 Kgs). & LED light fittings etc. (All the Street Light Pole Shall be of GI Tubular Pole and provision of a GI Junction box with Suitable Covers at a height of 1 Metre from the Ground. The Junction Box shall have Provision of Fuses, Buses, Connectors for cable in and out. (It Includes LED Lighting Fixtures with Lamps of 100Watts of OPTCL approved make & as per technical specification).	18	Nos
47.203	Outdoor Kiosk for Street Lighting Purpose having 2 Nos. 200Amp Switch Fuse Units and , 6 Nos. outlets of 32Amp MCB For Street Lighting. (Suitable For XLPE Cables (3.5C X 120Sqmm) from Main ACDB from Control Room to the Outdoor Kiosk. XLPE Cable Of 4C X 16Sqmm from Outdoor Kiosk to the Street Light Poles and 4C X 6Sq.mm from Pole to Pole and 2C X 6Sq.mm from Pole to Lighting Fixtures. 1 No. Outdoor Kiosk for Colony Supply Purpose (* Remarks: For Supply of All the Cables As Indicated Are Covered In the Cable Items As Indicated Above)	1	Nos
48.0	2 TR Capacity Split Air Conditioning Units (Inverter type latest model) of OPTCL approved make.	12	Nos
49.0	220kV GIS hall-ventilation system through ducting (Pressurization type ventilation system) at AHU room as per technical specification	1	LS
50.00	Fire Fighting System (Portable /Trolley/ Wheel Mounted Fire Extinguishers sets for Control Room, Equipment like Transformer and other areas as per Tech Spec.		
50.01	Foam Type-9 Ltrs	4	Nos
50.02	Dry Chemical Powder (Trolley Mounted)- 22.5Kgs	4	Nos
50.03	Dry Powder Type - 5Kgs	4	Nos
50.04	CO ₂ - 4.5Kgs	10	Nos
50.05	CO ₂ - 9Kgs	10	Nos
50.06	CO ₂ (Trolley Mounted)- 22.5Kgs	4	Nos
50.07	Fire Bucket (6 Nos in each stand) with stand	5	Sets
50.08	9 litre water type	4	Nos
50.09	4.5 kg DCP type	4	Nos
50.10	50 Litres Mechanical Foam type	2	Nos
50.11	Smoke & Heat detection system: Addressable optical Smoke & Heat Multi detector(50 Nos) for main control room building including all accessories, Main control panel(Microprocessor based 2 loop fire alarm control panel expandable upto 18 loops fully networkable with each loop capable of taking 99 devices, 8 line x 40 character alpha-numeric liquid crystal display .The panel shall be soft addressable type . The panel shall be able to give pin point location of all fire/fault conditions. Further, the panel must be able to automatically switch off respective control switches when ever any alarm is triggered. The panel shall have in built rectifier, Loop cards,provision for external & internal printer(if required), L C D unit to indicate Fire/Fault Signal with address and analog output, built in printer to log all fire or fault events complete in all respects, integral SMF lead acid batteries with sealed cells of 24 V capable of running for a minimum of 8 hours with integral battery charger complete as required and as per specification. The fire alarm panel shall be suitable for software integration with BMS & PA system ,wall mounting loop powered addressable type hooter with all accessories , addressable manual call box made of polycarbonate with plastic break glass front and complete with monitor module MCB, addressable isolator module with required PVC box, fittings and fixtures, wiring with PVC FRLS wire to cover the required for fire & smoke detection etc. (One control room building & 1 no. GIS hall are to be provided with Heat & smoke detection). Should have facility for integration with SAS.	1	Sets
51.00	Fire Fighting (HWV system & hydrant system) system with Detailed Design Suitable for 20MVA, 220/33kV Power Transformer etc., as per the Latest Standard & TS.		
51.01	Fire Fighting Equipment: (Main Pump, Jockey Pump, DG Set cum Pump, Control Panel for Fire Fighting System (HIGH PRESSURE : Hydrant and Mulsifire system) to take care of 1 No. 20 MVA, 220/33 KV POWER TRANSFORMER, switcyard equipment and buildings. HWV system & hydrant sytsem, complete with all piping, valves, fittings etc inside pump house for Fire protection sytem of substation) as per the technical spec & Latest standard.	1	Lot
51.02	Hydrant pipe for Substation fire protection system	0.08	km

51.03	Hydrant system, complete U/G piping of different sizes, valves and accessories etc outside the Pump House for Fire protection system of 1 Nos. 20 MVA, 220/33 KV POWER TRANSFORMER , switchyard equipment and buildings as per the technical spec & Latest standard.	1	Lot
51.04	HVV Spray system, Hydrant System and complete U/G and O/G piping, different type of valves, Fire sensor etc and accessories etc near the Transformer for Fire protection of 1 No. 20 MVA, 220/33 KV POWER TRANSFORMER , as per the technical spec.	1	Lot
52.00	Substation Automation System for 220/33kv Substation on Parallel redundancy protocol (PRP) mode: Design, Engineering, Drawing, Supervision, Installation, Testing & Commissioning of Substation Automation System along with Supply of the following 220 And 33kv level of Protection Panels consisting of Bay Control Units & Numerical Protection Relays and other Auxiliary Relays Suitable for SAS as Per Technical Specification. NOTE: All Protective Relays & BCU Shall Be Numerical Type.		
52.1	Gate way panel for Sub-Station Automation (in PRP as per the specification & indicative drg) system (for All 220 & 33 KV side bays including the future bays), other accessories (comprising servers, engg. Station, works station (Main & standby), Remote station control, Colour Laser jet Printers & dot matrix printer for local station as per requirement and also for remote station, Ethernet Switches , LIU, Red Box, Multimode glass fibre Double jacket armoured optical cables, special cables like F.O patch cord & armoured FO cables of adequate length etc required for the system in all respect as per latest IEC 61850 standard, Inverters of required capacity & rating (Input shall be both A.C & D.C and output shall be A.C) etc as per TS. A large video screen of 60 inches for display including all type of accessories & as per technical specification.	1.00	Sets
52.2	BCU for Substation Auxiliary System (Station AC, Station DC, Lighting, Fire fighting, Diesel generator etc. as per the site requirement)	1.00	Sets
52.3	220 KV PROTECTION PANELS		
52.31	Feeder Protection panel (Main-I , Main-II & Back-up protection with auto reclosure Distance Protection) with Bay control unit (BCU) for substation automation system. (Simplex with front Glass door)	4	Sets
52.32	Transformer Protection Panel (Differential I & II , REF I & II & Back-up Protection for HV & LV side Considering HV & LV side of 220/33kV, 20MVA) with Bay control units (BCU) for HV & LV for substation automation system. (Simplex with front Glass door)	1	Sets
52.33	Bus Coupler Protection Panel with Bay control unit (BCU) for substation automation system. (Simplex with front Glass door)	1	Nos
52.34	Bus-Bar Protection Panel (Provision of bus bar modules for the future bays and to be integrated with the Automation system) (Simplex with front Glass door).	1	Sets
52.35	Main 1 and Main 2 Distance and Line Differential Protection with all necessary modifications for two lines. (OPTCL's remote End Stations)	2	Nos
52.4	33 KV PROTECTION PANELS		
52.41	33kV Feeder Protection Panel with Bay control Protection unit (BCPU) for substation automation system	2.00	Nos
52.42	33kV Transformer Protection Panel with Bay control Protection unit (BCPU) for substation automation system (33kV side of 220/33kV, 20MVA)	1.00	Nos
52.43	33kV Transfer Bus Coupler Protection Panel with Bay control Protection unit (BCPU) for substation automation system.	1.00	Nos
53.00	AC & DC SYSTEM		
53.10	AC SYSTEM		
53.101	Main ACDB, Facilities for integration with SAS as per the site requirement, as per specification	1.00	Sets
53.102	ACDB as per Technical Specification.	1.00	Sets
53.103	Main Lighting Distribution Board as per Technical Specification	1.00	Sets
53.104	Indoor Lighting Distribution board as per Technical Specification	1.00	Sets
53.105	Emergency Lighting Distribution Board	1.00	Sets
53.106	Indoor Receptacle Board	2.00	Sets
53.20	220V & 48V DC System:		
53.201	220V DC BOARD (Having 100A DC MCCB as Incomer , E/F (Earth Leakage), Under & Over Voltage as per Specification (DCDB-1, DCDB-2 & B/C). Consider Separate Source (DC1 & DC 2) to each panels & accordingly sufficient Nos. of DC output from DB-1 & 2 to be considered. Facilities for integration with SAS as per the site requirement.	1	Sets
53.202	220V DC Emergency Distribution Board	1	Sets
53.203	Battery (350AH PLANTE type) for 220V DC	2	Sets
53.204	Battery Charger for 350AH, 220V DC (Float & Float cum Boost) (including provision of series dropper diodes with heat sinks & other protection facility at the DC Load terminal end in order to feed 220V to the load). Facilities for integration with SAS as per the site requirement.	2	Sets
53.205	DE MINERALISED PLANT of 30 L/Hr for making Distilled water for battery banks	1	Sets
53.206	48V DC BOARD (Having 75A DC MCCB as Incomer , E/F (Earth Leakage), Under & Over Voltage as per Specification (DCDB-1, DCDB-2 & B/C). Consider Separate source (DC1 & DC2) to each panels & accordingly sufficient Nos. of DC output from DB-1 & DB-2 to be considered. Facilities for integration with SAS as per the site requirement.	1	Sets
53.207	48V, 300 AH, VRLA type battery set	2	Sets
53.208	SMPS based battery charger for 48V, 75A float cum boost (as recommended by the Battery manufacturer)	2	Nos
54.00	Accessories for FOTE / OPGW System as per technical specification:		
54.01	24 Fibre (DWDM) OPGW fibre optic cable	0.1	Km
54.02	OPGW hardware set like suspension assembly, Tension Assembly (Dead end assembly, pass through assembly), vibration damper, down lead assemblies for 24/48 fibre (DWDM) OPGW, Joint box	1	Km
54.03	Optical line terminal equipment (OLTE)-STM4 type SDH equipment with integrated MUX & tributary cards for speech & data ports for interfacing of speech & data which should be compatible with existing OPTCL system.	1	Nos
54.04	Supply of FODP (Fibre optic Distribution panel) 48 F: Indoor type, rack mounted with FCPC coupling and pigtails (DWDM fibre)	1	Nos
54.05	Digital tele-protection coupler compatible for interfacing with SDHMUX	1	Nos
54.06	Earth flat, cable tray, telephone cable, ACDB, DCDB, foundation rail, Junction Box, Cat 5 cable & Misc items	1	Lot

55.00	EOT Crane for GIS building for 220kV GIS station (5T Capacity safe working load & minimum height of crane have shall be 8.0 meters or as per actual requirement whichever is higher. The crane shall have minimum speeds under full load of: Speed (a) Hoisting 2 meters/minute (b) Cross Travel 10 meters/minute (c) Long Travel 20 meters/minute (d) Creep speed shall be of 25% of operating speed. The crane shall be possible to be operated through the cable, through the pendant control and which shall be easily accessible from the floor of GIS building and through remote control device.) including all accessories with control panel.	1	Nos
56.00	DIFFERENT TYPE OF LATICE TYPE COLUMNS WITH DETAILS & DIFFERENT TYPE OF BEAMS WITH DETAILS		
56.01	(Tower) 220kV COLUMN: P1S TYPE,- HEIGHT-21.5 MTRS	14	MT
56.02	(Girder) 220kV BEAM:Q1 TYPE,-LENGTH-18 MTRS	3	MT
56.03	(Tower) 33kV COLUMN, HEIGHT-8 MTRS	9.7	MT
56.04	(Girder) 33kV BEAM:G1 TYPE,-LENGTH-5.5 MTRS	4.15	MT
57.00	SUPPORT STRUCTURES FOR OUDOOR EQUIPMENTS		
57.10	SUPPORT STRUCTURES FOR 220kV EQUIPMENT		
57.101	220kV Isolator	7	MT
57.102	220kV Surge Arrester	4	MT
57.103	220kV Current transformer	1.5	MT
57.104	220kV Potential transformer	1.2	MT
57.105	220kV Cable sealing end	1.5	MT
57.106	SF6 Bushing	4.5	MT
57.20	SUPPORT STRUCTURES FOR 33kV EQUIPMENT		
57.201	33 KV Lightning Arrestor	0.7	MT
57.202	33 KV Current Transformer	1.5	MT
57.203	33 KV Bus Potential Transformer	0.3	MT
57.204	33 KV Metering Current Transformer	0.6	MT
57.205	33 KV Metering VoltageTransformer	0.6	MT
57.206	33 KV Bus Post Insulator	3	MT
57.207	33 KV Horn Gap Fuse	0.64	MT
57.208	33 KV Isolator	2.32	MT
57.209	33 KV Isolator with ES	1.6	MT
57.210	Cable End Termination	0.8	MT
57.211	GI bolts ,Nuts, washers plain & spring etc for the above structures	2.18	MT
57.212	GI Foundation bolts & nuts with plate & other washers as required	3.95	MT
57.213	Triple Pole Structure for Double circuit 33kV Line: 3 Nos. Galvanized H-Type 14 Mtr. Structure including Channels, Angles and Flat for Belting, Bracing, mounting and termination of 6 Nos. 33kV Single core cable. This also includes supply of Lightning Arrestors, GO AB Switch, Polymer Pin & Disc Insulators incl. Hardware fittings, Complete Stay Ser, Earthing arrangement, HDPE Pipes from Ground Level to a Suitable Height on the Pole etc. to terminate the 33kV Cable on the structure complete. Note: Stringing of 148 Sq.mm. AAA Conductor from this Gantry to TFL Pump House is not included in above.	1	Lot
58.00	220kV XLPE Cable Package (220kV GIS station to MRSS station):		
58.01	Laying of 1C 220kV 1000 Sq.mm. Cu XLPE Cable as per the approved laying formation and including all accessories for cable tying & Belting	4832	Meters
58.02	STRAIGHT THROUGH JOINTING KITS FOR 220kV 1000 SQMM XLPE CABLE (with Link Boxes)	6	Nos
58.03	24 Fibre (DWSM) OPGW fibre optic cable	1.61	Km
58.04	installation hardware for 24 fibre optic cable	1	Lot
58.05	50mm DIA PVC PIPE / 40mm DIA PLB DUCT (OPTICAL FIBER CABLE)	1.61	Km
58.06	Cross bonding & Link Boxes for Earthing	2	Nos
59.00	SCHEDULE-2C-SS (CIVIL-ERECTION)		
60.00	SOIL INVESTIGATION & SITE LEVELLING		
60.01	Contour survey of the entire sub-station area including Supply of all labour & T&P	1	Lot
60.02	Soil investigation: Supply of labour,T&P and other necessary arrangements for Soil investigation/testing of the complete Substation Area.as per the site requirement,Technical specification & instruction of Engineer-in-Charge	1	Lot
60.03	SITE LEVELLING Providing, neatly dressing up and leveling of substation area to a required level as decided by the Engineer in Charge, the work includes removal, clearing of the entire area from vegetation, trees, bushes, uprooting of plants and disposal of surplus earth and unusable material from the site by means of any mechanical transport, if required as per direction of the Project In charge and as per Site Requirement, approved drawing and specification. This also includes excavation in all type of soils or rocks, back filling and disposal of excess earth or rocks to make the area to a level for construction as per scope and as per approved drawing and specification.		
60.031	Cutting of earth & filling of excavated soil	100.0	CuM
60.032	Filling with borrowed earth beyond 100 mtrs lead	100.0	CuM
61.00	220KV AND 33KV TOWERS AND OUTDOOR EQUIPMENT FOUNDATIONS: Supply & storage of Material/Raw Material i.e. Cement, water, reinforcement steel, coarse and fine aggregates (Sand and Metal Chips etc), Manpower, Tools & Plants, Machinery along with other required material for Design, engineering, and construction of PCC & M25 Design Mix RCC, footings of any depth, pedestal, excavation, concreting, shuttering, grouting, underpinning and back filling of foundations etc complete for switch yard gantry/ portal structures and equipment support & others as per the technical specification and approved drawings. This also includes excavation in all types of soil or rocks, back filling and disposal of excess earth as per the direction of Engineer In charge.		
61.01	Excavation & Back filling of excavated Soil	2333	Cum
61.02	PCC	74	Cum
61.03	RCC	401	Cum
61.04	Reinforcement Steel	143	MT

62.00	30 Mtr. Lighting cum Lightning Mast: Supply & storage of Material/Raw Material i.e. Cement, water, reinforcement steel, coarse and fine aggregates (Sand and Metal Chips etc), Manpower, Tools & Plants, Machinery along with other required material for Design, engineering, and construction of PCC & M25 Design Mix RCC, footings of any depth, pedestal, excavation, concreting, shuttering, grouting, underpinning and back filling of foundations etc complete for Lighting cum Lightning Mast as per the technical specification and approved drawings. This also includes excavation in all types of soil or rocks, back filling and disposal of excess earth as per the direction of Engineer In charge.		
62.01	Excavation & Back filling of excavated Soil	32	Cum
62.02	PCC	2.88	Cum
62.03	RCC	12.38	Cum
62.04	Reinforcement Steel	0.339	MT
63.00	CABLE TRENCH: Supply & storage of Material/Raw Material i.e. Cement, water, reinforcement steel, coarse and fine aggregates (Sand and Metal Chips etc), Manpower, Tools & Plants, Machinery along with other required material for Design, engineering, and construction of M25 Design Mix RCC cable trenches and all associated works for cable trench and cable trench crossings as per technical specifications and approved drawings and as per direction of the Engineer in Charge. (1) This also includes excavation in all types of soil or rocks, back filling, and disposal of excess earth as per the direction of Engineer In charge. (2) Design, Engineering, Providing and laying of plain cement concrete with approved quality coarse aggregates (Nominal size 12mm to 20mm), fine aggregates, cement in cable trench as blind layer inclusive of labour charges for concrete mixing & curing. This includes supply of all labourers, T&P and dewatering wherever required as per Technical specification and instruction of Engineer In charge. (3) Open cast foundation for the cable trench with RCC, including supply of Labour all materials like Reinforcement Steel, Cement, coarse and fine aggregates, shuttering, cutting, bending, binding of Reinforcement Steel including supply of binding wire proper curing of the foundations/concrete and T&P in line with the Specification and as per direction of Engineer in Charge. (4) Fly ash Brickwork, plastering & curing, wherever required including the supply of labour, material, cement, etc. (5) Fixing of MS Angle (G.I) for cable tray support (as per specification). The cable tray support frame shall be pre fabricated GI angle as per requirement and to be welded with the plate fixed on the trench wall for better rigidity. The plate (6mm) fixed on the wall are also to be welded with the Reinforcement Steel provided for the trench wall before concreting. (6) Precast of RCC covers and its fixing on the cable trench as per spec and instruction of Engg. In Charge. (7) CABLE TRENCHES INSIDE THE CONTROL ROOM SHALL BE COVERED WITH M.S CHEQUERED PLATE (Duly painted as per instruction of Engg in charge) INCLUDING STANDARD SUPPORT STAND {HD Galvanised (M.S JOIST ,CHANNEL,ANGLE)}..		
63.01	Section 1-1 (1275MM X 1400MM)	35	RM
63.02	Section 2- 2 (1275MM X900MM)	75	RM
63.03	Section 3-3 (1075MM X900MM)	25	RM
63.04	Section 4-4 (545MM X 250MM)	40	RM
63.05	BURIED CABLE TRENCH: Provision of Buried cable trench for 33kV Power cable, including excavation and backfilling and all relevant civil work as per TS and approved Drawing	135	RM
64.00	RAIN WATER HARVESTING: Rain water harvesting system as per Technical specification and approved drawing	2	Nos
65.00	SUBSTATION BUILDINGS:		
65.10	220KV GIS BUILDING (Approx. Area: Approx. 320 Sq.Mtr. & AHU Room Area: Approx. 34 Sq. Mtr.): Supply & storage of Material/Raw Material i.e. Cement, water, reinforcement steel, coarse and fine aggregates (Sand and Metal Chips etc), Manpower, Tools & Plants, Machinery along with other required material for Design, engineering and construction of M25 Design Mix RCC GIS Building, the cost of material, supply of labour, cement, reinforcement- steel, form work and excavation as per the approved drawing and technical specification. This also includes excavation in all types of soil or rocks, back filling, and disposal of excess earth as per the direction of Engineer In charge. As per approved drawings and specification. The area given is for reference only and may vary according to requirement of the equipment to be installed inside. The contractor shall finalize the dimensions according to the equipment offered by them providing enough space & access for erection, operation and maintenance & future expansion.		
65.101	RCC volume including Reinforcement Steel (including column ,Beams and roofs etc) as per technical spec & approved drawings.	1	Lot
65.102	Fly ash Brick masonry by using fly ash Brick work in cement sand mortar with Bricks of class designation 75 as per technical spec & approved drawings.	1	Lot
65.103	Flooring of GIS room shall be epoxy paint of adequate thickness & Flooring adjacent panel rooms shall be with vitrified digital tiles with dado as per technical spec & approved drawings.	1	Lot
65.104	External and internal wall (External (18mm thk) and internal (12 mm thk) wall and ceiling plastering as per technical spec mentioned in the civil section & approved drawings.	1	Lot
65.105	Provision of ceiling in the adjacent panel room area as per specification mentioned in the civil section & approved drawings.	1	Lot
65.106	Doors and windows shall be of sliding type with locking facility and shall be of aluminium with glaze of 6mm & windows shall have aluminium grills. As per technical spec & approved drawing.	1	Lot
65.107	Internal concealed wiring (including flexible copper FRP 1.1 KV PVC wire, conduits & its accessories, modular type switches & switch board, Junction boxes with required MCB & Earth leakage detector switchgear etc, fixing of lighting fixtures & switchgear , Erection of all Lighting FIXTURES & LAMPS (LED), D.C emergency lighting (including supply), cabling for EOT crane including supply and installation of Switch Board panel required for EOT crane as per approved drawing and direction of Engineer In charge.	1	Lot
65.108	Provision of smoke and fire detection & Alarm system of the building.	1	Lot
65.109	Provision of rails & other arrangement including all type of Civil works for EOT crane. This is as per the standard practice adopted in GIS sub-station and as directed by the Engineer in Charge.	1	Lot

65.110	Provision of rain water discharge pipes at different locations and etc as per requirement and approved drawing. It includes supply of all types of materials of reputed make, labour etc to complete the work.	1	Lot
65.111	External and internal wall painting with primer coat as per technical spec mentioned in the civil section. External: One coat weather coat primer + two coats of weather coat colour paint. Internal: Two coats wall putty+solvent thinable white primer of one coat+two coats colour paint. As per Technical Specification.	1	Lot
65.112	Installation of Ventilation system of all equipment and materials as per technical specification (design calculation to be submitted)	1	Lot
66.00	CONTROL ROOM BUILDING (Area: Approx. 382 Sq.Mtr.): Supply & storage of Material/Raw Material i.e. Cement, water, reinforcement steel, coarse and fine aggregates (Sand and Metal Chips etc), Manpower, Tools & Plants, Machinery along with other required material for Design, engineering and construction of M25 Design Mix RCC Control Room Building, the cost of material, supply of labour, cement, reinforcement- steel, form work and excavation as per the approved drawing and technical specification. This also includes excavation in all types of soil or rocks,back filling,and disposal of excess earth as per the direction of Engineer In charge. As per approved drawings and specification. The area given is for reference only and may vary according to requirement of the equipment to be installed inside. The contractor shall finalize the dimensions according to the equipment offered by them providing enough space & access for erection, operation and maintenance & future expansion.		
66.01	RCC volume including Reinforcement Steel (including column ,Beams and roofs etc) as per technical spec & approved drawings.	1	Lot
66.02	Fly ash Brick masonry by using fly ash Fly ash Brick work in cement sand mortar with Fly ash Bricks of class designation 75 as per technical spec & approved drawings.	1	Lot
66.03	Flooring with double charged vitrified digital tiles with dado in all the rooms, Bath and toilets shall be provided with anti skid ceramic digital tiles (wall of the same also to be provided with ceramic digital tiles), Acid proof industrial tiles to be provided on the floor and full wall of the battery room as per technical spec & approved drawings. Stair case & its landing platforms are to be provided with Granite flooring.	1	Lot
66.04	External and internal wall (External 18mm thk and internal 12 mm thk) wall ceiling plastering as per technical spec mentioned in the civil section and Building internal & external & ceiling paintings as per technical spec mentioned in the civil section. The ceiling of Battery room shall be acid proof paints as per specification & approved drawings.	1	Lot
66.05	Provision of ceiling in the control room area as per specification mentioned in the civil section & approved drawings.	1	Lot
66.06	Doors and windows shall be of sliding type with locking facility and shall be of aluminium with glaze of 6 mm & windows shall have aluminium grills. As per technical spec & approved drawing.	1	Lot
66.07	Internal concealed wiring (including flexible copper FRP 1.1 KV PVC wire,conduits & its accessories,modular type switches & switch board,Junction boxes with required MCB & Earth leakage detector switcghear etc),fixing of lighting fixtures & switchgear ,ceiling fans of 1400 sweep and regulators(including supply) ,exhaust fan (including supply), Erection of all Lighting FIXTURES & LAMPS (LED), D.C emergency lighting (including supply), as per approved drawing and direction of Engineer In charge.	1	Lot
66.08	Installation of smoke and fire detection & Alarm system of the building.	1	Lot
66.09	Supply, fitting and fixing of stainless steel pf 304 grade in hand railing using 50mm dia of 2mm thick circular pipe with balustrade of size 32mmx32mmx32mm @0.90mtr C/C and stainless square pipe bracing of size 32mmx32mmx32mm in three rows in staircase as per approved design and specification, buffing,polishing etc with cost, conveyance, taxes of all materials, labour, T&P etc required for the complete in all respect	1	Lot
66.10	External and internal wall painting with primer coat as per technical spec mentioned in the civil section. External: One coat weather coat primer + two coats of weather coat colour paint. Internal: Two coats wall putty+solvent thinable white primer of one coat+two coats colour paint. Refer the specification.	1	Lot
66.11	Provision of PHD and other fittings(in Toilets, wash room,overhead water tank of adequate capacity etc) of reputed make,provision of rain water discharge pipes at different locations and etc as per requirement and approved drawing. There shall be septic tank and soak pit of required capacity including complete sewage system as per approved drawing & technical specification & as per instruction of Engg- in-Charge. It includes supply of all types of materials of reputed make, labour etc to complete the work. Toilets for Gents & Ladies to be provided including all good quality reputed fittings as per technical specification. The toilets & wash room shall have antiskid floor tiles & wall tiles of seramic upto height of 8 feet.	1	Lot
67.00	SECURITY SHED & CUM VISITOR ROOM (Approx. Area: 17.5 Sq.Mtr.) : Supply & storage of Material/Raw Material i.e. Cement, water, reinforcement steel, coarse and fine aggregates (Sand and Metal Chips etc), Manpower, Tools & Plants, Machinery along with other required material for Design, engineering and construction of M25 Design Mix RCC Security Shed, the cost of material, supply of labour, cement, reinforcement- steel, form work and excavation as per the approved drawing and technical specification. This also includes excavation in all types of soil or rocks,back filling,and disposal of excess earth as per the direction of Engineer In charge. As per approved drawings and specification. The area given is for reference only and may vary according to requirement of the equipment to be installed inside. The contractor shall finalize the dimensions according to the equipment offered by them providing enough space & access for erection, operation and maintenance & future expansion. The height of the building shall be of 3.5mtrs RCC roof, Fly ash Brick masonry works, plastering and painting and fixing of MS doors and windows. Internal concealed wiring (including supply of flexible copper FRP 1.1 KV PVC wire,conduits & its accessories,modular type switches & switch board, Junction boxes with required MCB & Earth leakage detector switcghear etc), fixing of lighting fixtures & switchgear, ceiling fans of 1400 sweep and regulators (including supply) and provision of incoming AC supply from the main ACDB/outdoor kiosks installed for street light. Also includes painting of the building (in side and out side) as per recommended for colony building in the specification.	1	Lot

68.00	<p>STORE SHED (Area: Approx. 100 Sq.Mtr.): Supply & storage of Material/Raw Material i.e. Cement, water, reinforcement steel, coarse and fine aggregates (Sand and Metal Chips etc), Manpower, Tools & Plants, Machinery along with other required material for Design, engineering and construction of M25 Design Mix RCC Store Shed, the cost of material, supply of labour, cement, reinforcement- steel, form work and excavation as per the approved drawing and technical specification. This also includes excavation in all types of soil or rocks,back filling,and disposal of excess earth as per the direction of Engineer In charge. As per approved drawings and specification. The area given is for reference only and may vary according to requirement of the equipment to be installed inside. The contractor shall finalize the dimensions according to the equipment offered by them providing enough space & access for erection, operation and maintenance & future expansion. One no store shed of Approx. floor size of 10X10 mtr having Fly ash Brick walls and plastering with RCC roof. The flooring shall be of 75 mm thickness PCC over RR masonry works (as per standard practice of flooring). Provision of adequate nos of MS racks (proper paintings also to be done as per the direction of site in charge) for keeping the spare materials. The height of the shed shall be 4mtrs above the plinth. Internal concealed wiring (including supply of flexible copper FRP 1.1 KV PVC wire,conduits & its accessories, modular type switches & switch board, Junction boxes with required MCB & Earth leakage detector switchgear etc), fixing of lighting fixtures & switchgear, ceiling fans of 1400 sweep and regulators (including supply) and provision of incoming AC supply from the main ACDB/outdoor kiosks installed for street light. Also includes painting of the building (in side and out side) as per recommended for colony building in the specification.</p>	1	Lot
69.00	<p>VEHICLE PARKING SHED: Supply & storage of Material/Raw Material i.e. Cement, water, reinforcement steel, coarse and fine aggregates (Sand and Metal Chips etc), Manpower, Tools & Plants, Machinery along with other required material for Design, engineering and construction of M25 Design Mix RCC Vehicle Parking Shed. This also includes excavation in all types of soil or rocks,back filling,and disposal of excess earth as per the direction of Engineer In charge. The size of the parking area shall be 15mtrs X 15 mtrs, out of the entire area there shall be provision of shed for 5 mtrs X 15 mtrs and rest of the area shall be without shed. 100 mm thick PCC flooring after the preparing the foundation base & Roof of the parking place shall be RCC & Parking shed shall be as per TS & as per the direction of Engineer in Charge.</p>	1	Lot
70.00	<p>FIRE FIGHTING PUMP HOUSE BUILDING & ASSOCIATED RCC WATER TANKS: (Approx. Area of the FFPH Building: 50 Sq. Mtr.): Supply & storage of Material/Raw Material i.e. Cement, water, reinforcement steel, coarse and fine aggregates (Sand and Metal Chips etc), Manpower, Tools & Plants, Machinery along with other required material for Design, engineering and construction of M25 Design Mix FFPH building and allied Water Storage Tanks. This also includes excavation in all types of soil or rocks, backfilling and disposal of excess earth as per the direction of Engineer In charge. As per approved drawings and specification.</p>		
70.01	RCC volume including Reinforcement Steel (including column ,Beams and roofs etc) as per technical spec & approved drawings.	1	Lot
70.02	Brick masonry work in cement sand mortar with bricks of class designation 75kg/mm2 as per technical spec & approved drawings.	1	Lot
70.03	Concrete Flooring to be provided as per technical spec & approved drawings.	1	Lot
70.04	External and internal wall painting with primer coat as per technical spec mentioned in the civil section. External: One coat weather coat primer + two coats of weather coat colour paint. Internal: Two coats wall putty+solvent thinable white primer of one coat+two coats colour paint. Refer the specification.	1	Lot
70.05	Doors and windows shall be of sliding type with locking facility and shall be of aluminium with glaze of 6mm & windows shall have aluminium grills. As per technical spec & approved drawing.	1	Lot
70.06	Provision of PHD and other fittings of reputed make having ISI mark ,provision of rain water discharge pipes at different locations and etc as per requirement and approved drawing & technical specification & as per instruction of Engg- in-Charge. It includes supply of all types of materials of reputed make, labour etc to complete the work.	1	Lot
70.07	Internal concealed wiring,fixing of lighting fixtures(LED) ,fans and regulators(Electronic regulator) ,exhaust fan,D.C emergency lighting INCLUDING SUPPLY OF ALL ITEMS as per spec & approved drawing.	1	Lot
70.08	Provision of smoke and fire detection system of the building.	1	Lot
70.09	Provision of Water Tank for fire fighting as per TS and approved Drawings	1	Lot
71.00	External, internal, ceiling Plastering of Fire fighting as per approved drawing	1	Lot
72.00	<p>BOUNDARY WALL: Supply & storage of Material/Raw Material i.e. Cement, water, reinforcement steel, coarse and fine aggregates (Sand and Metal Chips etc), Manpower, Tools & Plants, Machinery along with other required material for Design, engineering and construction of Boundary Wall. The boundary wall shall be constructed to a height of 2 mtrs above finished ground level of the substation area with 10" wide brick masonry work with M25 Design Mix RCC ground tie beam to be rested on the RCC pillars (pillar to pillar distance @ 3mtrs). Supply & Fixing of Galvanised barbed wire (12 SWG) of 3-rows each on limb of Y shaped frame (Total 6 nos) fencing shall be provided on top of the boundary wall to a height of 0.5 mtr. This also includes excavation in all types of soil or rocks, backfilling and disposal of excess earth as per the direction of Engineer In charge.</p>	405	RM
73.00	<p>ROADS: Supply & storage of Material/Raw Material i.e. Cement, water, reinforcement steel, coarse and fine aggregates (Sand and Metal Chips etc), Manpower, Tools & Plants, Machinery along with other required material for Design, engineering and construction of roads and walkways/ shoulders within sub-station (Switch yard area, approach road, control room building area, main gate to the switch yard gate etc) as per specification, layout and approved drawings complete. This also includes excavation in all types of soil or rocks,back filling,and disposal of excess earth as per the direction of Engineer In charge. Provision of drains on both the side of the roads for easy discharge of rain water.</p>		
73.01	7.0 mtrs wide Main RCC road with kerb stones at both the side as per technical specification indicated in the civil section (from the switch yard main gate to power transformer, approach road & in front of GIS and control room building & Shall have drain on both side of the road.	200	Mtrs
73.02	3.75 mtrs wide Peripheral RCC with shoulder at both the side & shall have drain on both side of the road as per technical specification indicated in the civil section (Periphery roads outside switch yard fencing)	30	Mtrs

73.03	7.0 Mtrs wide Bituminous Road with shoulder & kerb stones at both sides from nearest Approach Road to the Main Gate of the Switchyard	1	Lot
74.00	DRAINAGE SYSTEM: Supply & storage of Material/Raw Material i.e. Cement, water, reinforcement steel, coarse and fine aggregates (Sand and Metal Chips etc), Manpower, Tools & Plants, Machinery along with other required material for Design, engineering and construction of storm water drainage scheme (RCC type), road-culverts as per specification and approved drawing. This also includes excavation in all types of soil or rocks, back filling, and disposal of excess earth as per the direction of Engineer In charge. All the switch yard bays, roads water drainage shall be connected to the main surface drain. As per approved drawing and specification.		
74.01	Storm water drain (RCC type)	460	Mtrs
74.02	Road-culverts, drain crossings (RCC type) pipe	1	Lot
74.03	Cable Trench Crossing	1	Lot
75.00	220/33kV POWER TRANSFORMER FOUNDATION-1No Design, engineering, supply of labour, material, equipments for construction of Transformer foundation, all associated works, rail tracks, jacking pads, anchor block RCC and PCC, miscellaneous structural steel including oil collection pits, MS grating (if required), gravel filling, and other items etc. not mentioned herein, but specifically required for the completion of the work as per technical specification and approved drawing. (Rate shall be inclusive of cement, reinforcement steel, angles, flats and form work etc.). Transformer RCC foundation and Rail Track should be extended upto the approaching road (However, the height of RCC foundation beyond transformer main plinth area should be same as height of concrete road). This also includes excavation in all types of soil or rocks, back filling, and disposal of excess earth as per the direction of Engineer In charge.		
75.01	The rails shall be first quality 52 kg/m medium manganese steel as per Indian Railway specification T-12-64 and its subsequent revision, joined together by fish plates as per Indian Railway specification T-1/57, and 27 mm diameter fish bolts.	30	RM
75.02	Excavation & Back filling of excavated Soil	80	Cum
75.03	PCC	7.5	Cum
75.04	RCC	35	Cum
75.05	Reinforcement Steel	3	MT
75.06	Other Supply & erection of material in order to complete the Power transformer foundation	1	Lot
76.00	OIL SUMP PIT-1 No Design, engineering, supply of labour, material, equipments for construction of Oil collection (from transformers) sump pit with provision of pump (5 HP, with auto level control, including cabling, fixing of control gear) & pump house over the oil sump pit (as per CIGRE standard) for the oil collection pit in order to separate oil from the water. Other piping arrangement shall be provisioned to remove water from the oil sump pit. Oil capacity of power transformer in ltrs approx. 20 MVA 220/33KV: 50000 ltrs.		
76.01	Excavation	62	Cum
76.02	PCC	0.9	Cum
76.03	RCC	17.81	Cum
76.04	Reinforcement Steel	0.8	MT
76.05	Other Supply & erection of material in order to complete the Oil Sump pit	1	Lot
77.00	PCC BEFORE SITE SURFACING: Design, engineering, supply of labour, material, equipments for Leveling of earth after erection of structures and equipments and proper compaction by using roller of adequate capacity (minimum 3 Ton capacity) with water sprinkling of switch yard area. After proper leveling of the switch yard area (after anti-weed treatment), spreading of plain cement concrete using 20 mm nominal metal over a layer of good quality river sand of 25 mm and maintaining proper sloping for easy discharge of storm water having concrete thickness of 75 mm. including rolling, dressing, compacting the area.	310	Cum
78.00	METAL SPREADING: Providing supplying and laying two layers of machine crushed metals (gravel) fill, the first layer after compaction shall make minimum 50 mm thickness coarse/ layer of 20 mm nominal size consolidated/ compacted and (by using roller as specified in the specification). A final layer of 50 mm thickness of machine crushed 20 mm nominal size of metals (gravel) above the first layer of 50 mm thickness above the PCC. The total compacted thickness of the metals (20 mm Nominal) 100mm above the PCC.	413	Cum
79.00	PROVISION OF GARDEN: Provision of gardens as per approved Drawing including supply and planting of decorative plants, garden grass, flowering plants, soil treatment. Provision of water tap with water sprinkler arrangement including water pipe laying with control at different location. Both side of the RCC roads shall be provided with decorative plants as per approved drawing.	1	Lot
80.00	STONE PITCHING & TOE WALL: Stone pitching including making of toe walls both at top and bottom, including surface drain both at top and bottom and partition wall in every 10 mtrs by using boulders and RR masonry walls respectively. This also includes excavation in all types of soil or rocks, back filling, and disposal of excess earth and supply of materials and labour as per the direction of Engineer In charge and as per approved drawing and specification.		
80.01	Excavation of Soil	1	Lot
80.02	P.C.C (1:3:6): Lean Concrete Grade M-10 (Below RR)	1	Lot
80.03	RR Masonry (1:5)	1	Lot
80.04	P.C.C (1:2:4): Lean Concrete Grade M-15 (above RR)	1	Lot
81.00	SWITCHYARD FENCING: Supply and fixing of G.I coat mesh (2.5mm dia) in a (G.I angle 50 X 50 X 6 mm frame having 50 X 6 mm G.I flat bracing corner to corner) fencing (the post and link shall be of HD galvanized) in switchyard and other area of the substation with total fence height complete as per specification and approval drawing and as required under the safety regulation of local, state and central government bodies. This also includes PCC work for grouting the Post and a continuous fly ash brick masonry work and cement point of the joint for the fence upto a height from FGL.	360	Mtr

82.00	2 x 250KVA STATION TRANSFORMER FOUNDATION: Design, engineering, procurement of labour, material including all associated works for construction of foundation for station transformers as per approved drawing and specification.(other accessories & materials as required need to be supplied for complete installation of transformer as per standard) and instruction of Engineer In charge. As per the specification and approved drawing.		
82.01	Excavation & Back filling of excavated Soil	35	Cum
82.02	PCC	0.7	Cum
82.03	RCC	5.3	Cum
82.04	Reinforcement Steel	7	MT
83.00	MAIN GATE & SWITCH YARD GATES: Design, engineering, procurement of labour, material including all associated works for construction and fixing of main gate and switch yard gates as per specification and approved drawing. This also includes excavation in all types of soil or rocks, back filling, and disposal of excess earth as per the direction of Engineer In charge. Provision of gate lights (Post top lantern type) on each pillar of the gate. It includes supply & fixing of light fixtures including LED Gate lamp, LV XLPE cables, switchgear etc required to complete works as per specification and approved drawings		
83.01	6m Wide Boundary wall Main gate	1	Nos
83.02	1.5m Wide Boundary wall Wicket gate	1	Nos
83.03	5m Wide Swithyard Fence Gate	2	Nos
84.00	BOREWELL: Including supply, fixing and commissioning of 1 Nos. 3 HP submersible water pump with starter and other protection.	1	Lot
85.00	COLOUR CODING AND BAY MARKING: Design, engineering, procurement of labour, material including all associated works for the followings. This should be as per direction of site In charge a) Color coding (red, Yellow & Blue) for equipments, Bus gantry & column of entire switch yard. Good quality weather proof sticker may be used for identification. b) Each bay should be identified with the help of bay marker sign board, suitably grouted. MS sign board with stand to be installed. Proper painting and lettering to be done of the entire switch yard area.	1	Lot
86.00	ANTI WEED TREATMENT: Supply of labour, T&P, Chemicals and other necessary arrangements for anti-weed treat of the switch-yard areas, control room etc.as per the instruction of Engineer-in-Charge. The chemical to be sprayed as per the standard practice adopted for antiweed treatment of sub-station area & as per the technical specification.	3100	Sq.Mtr.
87.00	WATER PIPING: Provision of water discharge (PVC) pipe from borewell pump house to different location and etc as per requirement and approved drawing it also includes supply of all type of materials of reputed make	140	Mtrs
88.00	250KVA DG SET FOUNDATION:		
88.01	PCC	1.3	Cum
88.02	RCC	23	Cum
88.03	Reinforcement Steel	2.8	MT
89.00	220 kVCable package, 1CX 1000 sq mm cable(GIS Station to MRSS Station):		
89.01	Cable Trench excavation and backfilling of all types of soil (750 meter Long and 2m deep from GIS Station to MRSS Station).	2550	Cum
89.02	River Sand filling of 300 mm depth on buried area	450	Cum
89.03	Remaining sand filling area to fillup the Trench upto 1.4 depth on buried area	2100	Cum
89.04	Cable protection RCC COVER 650X450 on buried area	50	Cum
89.05	1 Nos. Cable Jointing chamber (Approx. Size 12000 x 3000 x 2500 mm) with cover		
89.06	Excavation & Back filling of excavated Soil	100	Cum
89.07	PCC	2.25	Cum
89.08	RCC	35	Cum
89.09	Reinforcement Steel	1.75	MT

Annexure III

Project Bill of Quantities – Mandatory Spares

90.0	MANDATORY SPARES REQUIRED FOR 220/33KV TFL GIS SUBSTATION AT ANGUL, ODISHA]		
91.00	20MVA 220/33KV TRANSFORMER		
91.01	220kV bushing complete in all respects.	1.00	Nos
91.02	36kV bushing complete in all respects	1.00	Nos
91.03	HV Neutral Bushing with metal parts and gaskets	1.00	Nos
91.04	LV Neutral Bushing with metal parts and gaskets	1.00	Nos
91.05	Local and Remote Winding Temperature Indicator with contact and sensing device	1.00	Sets
91.06	Oil Temperature Indicator with contact and sensing device (Local and Remote)	1.00	Sets
91.07	Pressure relief valve	1.00	Nos
91.08	Magnetic oil level gauge with low oil level alarm contacts	1.00	Nos
91.09	Cooler fan with motor	1.00	Nos
91.10	Buchholz relay	1.00	Nos
91.11	Set of starter, contactor relays and switches(1 No of each type)	1.00	Sets
91.12	Tap position indicator (local & remote)	1.00	Nos
91.13	Fuses (complete 100 % replacement for transformer)	1.00	Lot
91.14	Lamps (complete 100% replacement for transformer)	1.00	Lot
92.00	SPARES FOR 220kV GIS SWITCHGEAR		
92.10	220kV GIS (GENERAL):		
92.101	Complete GIS modules, along with enclosure, all active parts such as conductor, conductor joints, shields end covers etc., for each type: 1. Bus bar sections (including bus bar interconnection modules) 2. Bus Ducts sections (including compensators/expansionjoints/bellows) 3. Bends 4. SF6/Air Bushing 5. Cable termination kit	1.00	Sets
92.102	SF ₆ Gas Pressure Relief Device assembly of each type	1.00	Sets
92.103	SF ₆ Pressure Gauge cum switch/Density monitors and pressure switch as applicable, of each type	5.00	Sets
92.104	Coupling device for pressure gauge cum switch for connecting gas handling plant of each type	2.00	Sets
92.105	Rubber gasket, 'O' rings and seals of SF ₆ gas for GIS enclosure type	5.00	Sets
92.106	Molecular Filter for SF ₆ Gas with Filter Bags (10% of total weight)	1.00	Sets
92.107	Control valves for SF ₆ gas of each type	3.00	Sets
92.108	SF ₆ gas (20% of total gas quantity)	1.00	Lot
92.109	Pipe length(copper or steel as applicable) for SF ₆ circuit of each type(if applicable)	2.00	Sets
92.110	Locking device to keep the Disconnectors (isolators) and Earthing/Fast earthing switches in close or open position in cae of removal of the driving mechanism	2.00	Sets
92.111	UHF PD sensors of each type along with BNC connector	5.00	Sets
92.112	Support Insulators (gas through) of each type (complete with metal ring etc.,)	10.00	Nos
92.113	Gas Barriers of each type (complete with metal ring etc.,)	10.00	Nos
92.114	SF ₆ to Air bushing of each type complete in all respect	2.00	Nos
92.20	220kV GIS CIRCUIT BREAKER		
92.201	Complete circuit breaker(one phase) without PIR with interrupter,main circui, enclosure and Marshalling Box with operating mechanism to enable one to one replacement of applicable type of CB by spare	2.00	Sets
92.202	Fixed , moving and arcing contacts including insulating nozzles of each type (for main chamber)	1.00	Sets
92.203	Trip Coils with Resistor as applicable	3.00	Sets
92.204	Closing Coils with resistor as applicable	3.00	Sets
92.205	Relays, Power Contactors, push Buttons, timers & MCB etc.of each type and rating	1.00	Sets
92.206	Auxiliary Switch Assembly	3.00	Sets
92.207	Operation Counter	3.00	Sets
92.208	Windscope, Observing Window of each type)	2.00	Sets
92.21	For Spring Operated Mechanism		
92.211	Complete Spring operating mechanism, Including charging mechanism etc.of each type	3.00	Sets
92.212	Spring Charging motor	2.00	Sets
92.30	220kV GIS CURRENT TRANSFORMER		
92.301	Complete CT of each type and rating as supplied with enclosure and primary conductors to enable one to one replacement of all applicable type/rating of CT by spare.	2.00	Nos
92.40	220kV GIS VOLTAGE TRANSFORMER		
92.401	Complete PT of each type with enclosure to enable one to one replacement of all applicable type/rating of VT by spare (if applicable)	1.00	Nos.

92.50	220kV GIS DISCONNECTING/EARTHING SWITCHES		
92.51	Complete set of 3-phase dis-connector of each type including main circuit, enclosure, driving mechanism and support Insulator etc. to enable complete one to one replacement of all applicable type of Isolator by spare	1.00	Sets
92.52	Complete set of 3-phase Maintenance Earthing switch of each type, including main circuit, enclosure, driving mechanism and support Insulator etc to enable complete one to one replacement of all applicable type of Earth Switch by spare	1.00	Sets
92.53	Complete set of 3-phase Fast Earthing switch of each type, including main circuit, enclosure, driving mechanism and support Insulator etc. to enable complete one to one replacement of all applicable type of Earth Switch by spare (if applicable)	1.00	Sets
92.54	Copper Contact fingers & corona shield for disconnector male & female contact for one complete (3-Phase) disconnector of each type	1.00	Sets
92.55	Copper Contact fingers & corona shield for Maintenance Earthing switch male & female contact for one complete (3-Phase) earthing switch of each type	1.00	Sets
92.56	Open/close contactor assembly, timers, key interlock, interlocking coils, relays, push buttons, indicating lamps, power contactors, resistors, fuses, MCBs & drive control cards etc., one of each type for one complete MOM box		
92.561	For Disconnector	2.00	Sets
92.562	For Maintenance Earth switch	2.00	Sets
92.563	For Fast Earthing switch (if applicable)	2.00	Sets
92.57	Limit Switches and Aux. switches for one complete MOM box		
92.574	For Disconnector	2.00	Sets
92.575	For Maintenance Earth switch	2.00	Sets
92.576	For Fast Earthing switch (if applicable)	2.00	Sets
92.59	Drive Mechanism of each type		
92.587	For Disconnector	2.00	Sets
92.588	For Maintenance Earth switch	2.00	Sets
92.589	For Fast Earthing switch (if applicable)	2.00	Sets
92.60	Motor for Drive mechanism of each type		
92.600	For Disconnector	2.00	Sets
92.601	For Maintenance Earth switch	2.00	Sets
92.602	For Fast Earthing switch (if applicable)	2.00	Sets
92.61	Local Control Cubicle (LCC)		
92.613	Aux. relays, contactors, Push buttons, switches, Lamps, Annunciation windows, MCB, Fuses, Timers, Terminal Blocks etc., of each type & rating	5.00	Sets
93.00	SPARES FOR 220kV OUTDOOR EQUIPMENT		
93.10	220kV ISOLATOR AND EARTH SWITCH		
93.11	Complete set of 3 Nos. of single phase/1 Nos. of three phase WITH earthing switch including main circuit enclosure and driving mechanism	1.00	Sets
93.12	Copper contact fingers for disconnector male and female contact for one complete (3 phase) disconnector of each type and rating	1.00	Sets
93.13	Copper contact fingers for earthing switch male and female contact for one complete (3 phase) Earth switch of each type and rating	1.00	Sets
93.14	Limit switches and auxiliary switches for complete three phase equipment		
93.141	a) For isolator	2.00	Sets
93.142	b) For earth switch	1.00	Sets
93.15	Rotor housing bearing assembly for complete three phase equipment		
93.153	a) For isolator	1.00	Sets
93.154	b) For earth switch	1.00	Sets
93.16	Bearing for three phase equipment		
93.165	a) For isolator	3.00	Sets
93.166	b) For earth switch	1.00	Sets
93.18	Interlocking coil with resistor, timers, key interlock for complete three phase	1.00	Sets
93.19	Relays, Power Contactors, push Buttons, timers & MCB etc. of each type and rating		
93.187	a) For isolator	3.00	Sets
93.188	b) For earth switch	1.00	Sets
93.20	Auxiliary Switch Assembly with NO + NC (3 nos. of each type)	1.00	Sets
93.20	SPARES FOR TARIFF METERING CURRENT TRANSFORMER		

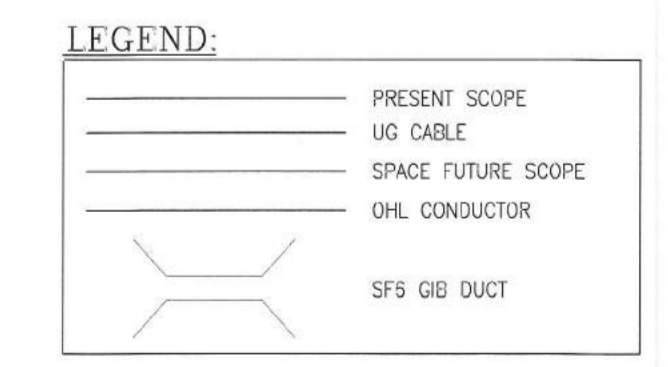
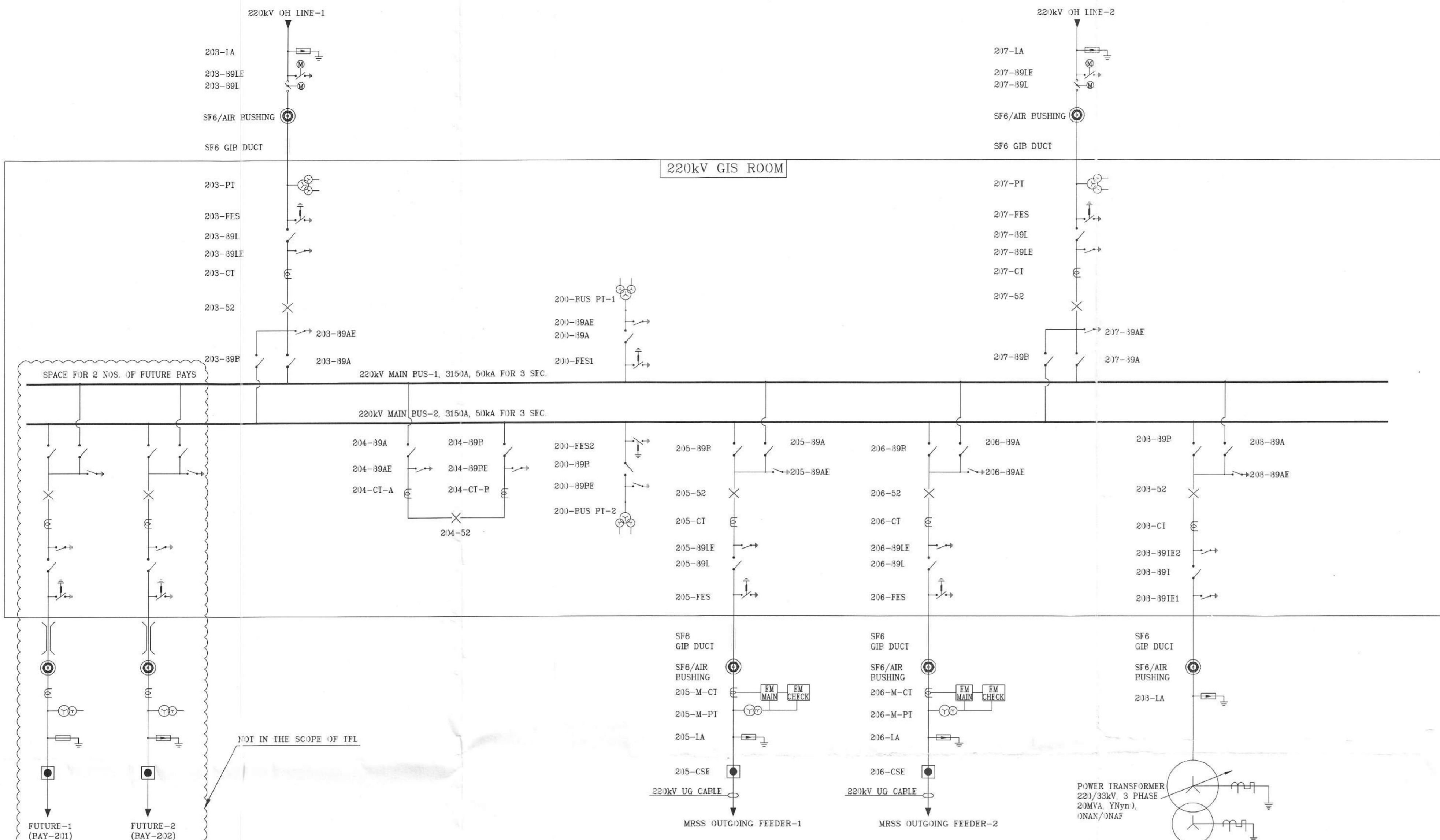
93.21	220kV, single phase current transformer, 5 core, ratio 1200-600-300A/1-1-1-1-1A, CL- 4-PX & 1-0.2S, 30VA Metering CT complete with mounting hardware	2.00	Nos
93.30	SPARES FOR TARIFF METERING VOLTAGE TRANSFORMER		
93.31	220kV, single phase voltage transformer ratio 220KV/ $\sqrt{3}$ /110V/ $\sqrt{3}$ V, CL-0.2, 50VA with mounting hardware	2.00	Nos
93.40	SPARES FOR SURGE ARRESTOR		
93.41	216kV Zinc Oxide Gapless Surge Arrestor with counter and leakage meter	2.00	Nos
94.00	SPARES FOR 33kV OUTDOOR EQUIPMENT:		
94.01	33kV Outdoor VCB, 1250A, 31.5kA/3s	1.00	Nos
94.02	33kV Single phase current transformer, 5 core, ratio 800-400-200/1A	1.00	Nos
94.03	33kV Single Phase, Potential Transformer, 2 core (0.2,3P classes), 33kV/110V/110V	1.00	Nos
94.04	33kV, 1250A, 31.5kA/1s, Single phase, Outdoor Isolator with Earth Switch	1.00	Nos
94.05	30kV Metal Oxide Surge Arrestor, 10kA, Long duration discharge class III as per technical Specification.	1.00	Nos
94.06	33kv, 200A, Horn Gap fuses	1.00	Nos
95.00	SPARES FOR 220V/48V DC BATTERIES		
95.01	Spare battery cell for 220V, 350AH battery w/o electrolyte	5.00	Nos
95.02	Vent Plugs	10.00	Nos
95.03	Float level Indicators	10.00	Nos
95.04	Terminal connectors with nuts & bolts	10.00	Nos
95.05	Spare battery cell for 48V, 300AH battery w/o electrolyte	5.00	Nos
95.06	Vent Plugs	10.00	Nos
95.07	Float Indicators	10.00	Nos
95.08	Terminal connectors with nuts & bolts	10.00	Nos
95.09	Electrolyte	160.00	Litres
95.10	Battery maintenace log sheet books for two years	1.00	Sets
96.00	SPARES FOR 220V/48V DC BATTERY CHARGER & DCDB		
96.01	Voltage regulator cards	1.00	Nos
96.02	Protection card (if any)	1.00	Nos
96.03	Thyristor(SCR)	2.00	Nos
96.04	Rectifier Diodes	2.00	Nos
96.05	Blocking diode	1.00	Nos
96.06	Filter capacitor	1.00	Sets
96.07	Auto-manual switch	1.00	Nos
96.08	Indicating LED	10.00	Nos
96.09	indicating fuse (if any)	10.00	Nos
96.10	Input AC contactor	1.00	Nos
96.11	Rectifier H.R.C fuses	4.00	Nos
97.00	SPARES OF LT SWITCHGEAR		
97.01	Auxiliary Relays (1 No. of each type)	1	Sets
97.02	CTs and PTs (1 No. of each type)	1	Sets
97.03	Switches/Push buttons and Meters (1 No. of each type)	1	Sets
97.04	MCCB (1 no. of each type and rating)	1	Sets
97.05	TPN Switches/MCB DP (1 No. of each type and rating)	1	Sets
97.06	Voltmeters	1	Nos
97.07	Ammeter	1	Nos
97.08	TNC switch for breaker	2	Nos
97.09	Hooter	2	Nos
97.10	O/C & E/F relay	1	Nos
97.11	Over Voltage coil	2	Nos
97.12	Auxiliary contactors (1 No. of each type)	1	Sets
97.13	L.T. Breaker Spares		
97.1301	a) Spring charging motor (1 No. of each type)	1.00	Sets
97.1302	b) Aux. Contact sets (each type)	2.00	Sets
97.1303	c) Busbar Seal off insulators	5.00	Nos
97.1304	d) Arc-chutes	1.00	Sets
97.1305	e) Moving contacts (1 No. of each type)	1.00	Sets
97.1306	f) Arcing contacts (Fixed/Moving) (1 No. of each type)	1.00	Sets
97.1307	g) Springs (Closing/Opening) (1 No. of each type)	1.00	Sets
97.1308	h) Closing coil	1.00	Nos
97.1309	i) Tripping coil	1.00	Nos
97.1310	j) Aux. finger contact (1 No. of each type)	1.00	Sets
97.1311	k) Limit switches (1 No. of each type)	1.00	Sets
97.1312	l) Jaw contacts (1 No. of each type)	1.00	Sets
97.1313	m) 415V, 800A Air circuit Breaker	1.00	Nos
97.14	Busbar		
97.142	a) Busbar insulators	5.00	Nos
97.143	b) Interphase barrier	2.00	Nos
97.144	c) Busbar strip (Aluminium)	5.00	Mtrs
98.00	SPARES FOR RELAY AND PROTECTION PANELS 220KV		

98.10	220kV LINE PROTECTION PANEL SPARES		
98.101	Main - 1 Numerical Distance Relay with Software (excluding external Trip Relay)	1	Sets
98.102	Main - 2 Numerical Current Differential Relay with Software (excluding external Trip Relay)	1	Sets
98.20	220kV TRANSFORMER PROTECTION PANEL SPARES		
98.203	Numerical Differential Relay	1	Nos
98.204	Numerical Restricted Earth Fault Relay	1	Nos
98.205	Numerical Over Current Earth Fault Relay	1	Nos
98.206	Numerical Breaker Failure Relay -If used	1	Nos
98.207	Trip Circuit Supervision Relay	2	Nos
98.208	Self Reset Trip Relay (1 No. of each type)	1	Sets
98.209	Hand Reset Trip Relay (1 No. of each type)	1	Sets
98.210	Timer Relay (1 No. of each type) -If used	1	Sets
98.211	DC Supervision Relay	1	Nos
98.212	Auxiliary Relays (1 No. of each type)	1	Sets
98.213	High Speed Tripping relay	1	Nos
98.30	220kV BUSBAR PROTECTION PANEL SPARES		
98.31	Power Supply Modules for Bus Bar Protection (1 No. of each type)	3	Sets
98.32	Metrosil (Non - Linear Resistor) (1 No. of each type)	1	Sets
99.00	SPARES FOR SUB STATION AUTOMATION SYSTEM		
99.01	Fan assembly used for Master station, HMI, Printer server (each type)	1	Sets
99.02	Bay Control Unit of each type with configuration software	2	Sets
99.03	Auxiliary relays used in bay control unit for control applications (10% of Total)	1	Lot
99.04	FO patch card of each type	5	Sets
99.05	OFC cable	500	Mtrs
99.06	optical loss measuring kit with relevant accessories and visual Fiber Optic cable inspection aid for optical fibre cable	1	Sets
99.07	Industrial Ethernet switch of each type	1	Sets
100.00	SPARES FOR EOT CRANE		
100.10	Spares for 220kV GIS Hall Crane		
100.101	Pair of brake shoe with lining for each size of brake used viz. D.C. operated E.M, or Hydraulic thruster operated.	4	Sets
100.102	Pair of brake linings with rivets for each size of brake used.	4	Sets
100.103	Main springs for each size of brake used.	4	Nos
100.104	Brake coils for each size of brake used.	4	Sets
100.105	Thruster of each size used.	2	Nos
100.106	Pair of oil seals for each gear box used on crane.	4	Sets
100.107	Contactors of each size used.	4	Sets
100.108	Fixed & moving contacts of each size contactor used.	2	Sets
100.109	3 Nos. Coils for each size of contactor used.	2	Sets
100.110	Overload relay for each motor.	2	Nos
100.111	Timers	6	Nos
100.112	3 No. fuse links of each sizes used on crane	4	Sets
100.113	1 Printed circuit breaker of each size and type	1	Sets
100.114	Complete set of lamps for lightning and signals	1	Sets
100.115	Carbon brushes & holdings for each slip ring motor	4	Sets
100.116	Fuse links of each size used	4	Sets
100.117	Resistance element of each size and type	1	Sets
100.118	Communication Card/cable	1	Sets
100.119	I/O Card	1	Sets
100.120	Processors	1	Sets
100.121	Indicating lamps	1	Sets
101.00	SPARES FOR FIRE DETECTION AND FIRE EXTINGUISHING SYSTEM		
101.01	Fitted Nitrgen Cylinder	2	Nos
101.02	Pipes with fittings	1	Nos
101.03	Heat Sensor assembly	1	Nos
101.04	Fire Survival cable sufficient for one system	1	Nos
101.05	Fire Detectors	6	Nos
101.06	Thermostat	2	Nos
102.00	SPARES FOR FIBER OPTICAL TERMINAL EQUIPMENT (FOTE)		
102.01	Power Supply Card (48 V DC)	1	Nos
102.02	Control Card with alarm cables and terminals	1	Nos
102.03	STM - 1 OLTE - 4 SFP cages excluding SFP	1	Nos
102.04	SFP U1.2 (1550 nm for Distance of 160 km)	1	Nos
102.05	Fibre Patch Cord for OLTE - 10 m	4	Nos
102.06	2/4 wire E & M speech interface card ports	1	Nos
102.07	Integrated teleprotection couler - 4 commands	1	Nos
102.08	Low and High Speed data Interface Card - 4 Ports	1	Nos

Annexure IV

List of Tender Drawings

- 1) 220/33 kV GIS Switching Substation – Single Line Diagram
- 2) 220/33 kV GIS Switching Substation – Protection Single Line Diagram
- 3) 220/33 kV GIS Switching Substation – Plant Layout
- 4) 220/33 kV GIS Switching Substation – Reference Drawing for Architectural Drawing for GIS & CRB
- 5) 220/33 kV GIS Switching Substation – Reference Drawing for Plan Layout for FFPH & Water Tank
- 6) 220/33 kV GIS Switching Substation – Reference Drawing for Valve Schedule for FFPH
- 7) Plot Plan Layout (Reference)
- 8) 220/33 kV GIS Switching Substation – Reference Drawing for ACDB & DCDB Single Line Diagram
- 9) 220/33 kV GIS Switching Substation – Reference Drawing for Cable Trench Section
- 10) 220/33 kV GIS Switching Substation – Reference Drawing for Parking Shed
- 11) 220/33 kV GIS Switching Substation – Reference Drawing for Store Room Architecture
- 12) 220/33 kV GIS Switching Substation – Reference Drawing 3-Pole Structure (33kV O/G)
- 13) 220kV U/G Cable Route



NOT IN THE SCOPE OF TFL

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220kV OUTDOOR EQUIPMENT:

SL.NO.	SYMBOL	DESCRIPTION	RATING	STRUCTURE QUANTITY		EQUIPMENT QUANTITY	
				AS PER ACTUAL	AS PER P/Q	AS PER ACTUAL	AS PER P/Q
01		POWER TRANSFORMER	220/33KV, 3-PH, 20MVA, YNd1, ONAN/ONAF, BUSHING LV NCT 800-400-200/1A, CL, PS, 1C, BUSHING HV NCT 120-80/1A, CL, PS, 1C	-	-	01 NOS.	01 NOS.
02		LIGHTNING ARRESTER	215KV, 10KA, CLASS III, 1-PH	15 NOS.	15 NOS.	15 NOS.	15 NOS.
03		METERING VOLTAGE TRANSFORMER	245KV, CL.0.2, 50VA, 220KV/110V, 5 CORE	06 NOS.	06 NOS.	06 NOS.	06 NOS.
04		METERING CURRENT TRANSFORMER	245KV, 1200-500-300/1A, CL-0.25, 30VA, 5 CORE	06 NOS.	06 NOS.	06 NOS.	06 NOS.
05		CABLE SEALING END	245KV	05 NOS.	05 NOS.	05 NOS.	05 NOS.
06		SF6/AIR BUSHING	245KV, 3150A	-	-	15 NOS.	15 NOS.
07		HORIZONTAL DOUBLE BREAK ISOLATOR, MECHANICALLY GAUGED MOTOR OPERATED ISOLATOR WITH O/E MANUAL OPERATED EARTH SWITCH	220KV, 3150A, 50KA FOR 1sec, 3PH	05 NOS.	05 NOS.	05 NOS.	05 NOS.

220kV GIS EQUIPMENT:

SL.NO.	DESCRIPTION	RATING	STRUCTURE QUANTITY		EQUIPMENT QUANTITY	
			AS PER ACTUAL	AS PER P/Q	AS PER ACTUAL	AS PER P/Q
01	245KV, 3150, 50KA (Specs for CB & 1 sec for Disconnector, grounding switch, CT, PT), SF6 gas insulated transformer feeder bay module each comprising of SF6 gas insulated circuit breaker, current transformer, bus-bar disconnects with common grounding switch, motorised disconnectors with safety grounding switch(es), high speed fault making motorised grounding switch, stand alone local control SF6 gas monitoring system for complete bay, SF6 bus duct termination arrangement, PO sensor (adequate number of UHF sensors in the offered GIS equipment for detection of partial discharge (of SpC & above) as per IEC 60270 through partial discharge (PD) monitoring system), different gas compartment, O-ring & gaskets, nuts, bolts & washers absorbent limit switch, SF6 gas, etc. to complete transformer feeder bay module & its earthing arrangement with earthing strips of adequate size as per the technical specification.	245KV, 3150A, 50KA for 3 secs	-	-	01 SET.	01 SET.
02	245KV, 3150, 50KA (Specs for CB & 1 sec for Disconnector, grounding switch, CT, PT), SF6 gas insulated line feeder bay module each comprising of SF6 gas insulated circuit breaker, current transformer, line potential transformer (3-Core), bus bar disconnectors with common grounding switch, motorised disconnectors, with safety grounding switch(es), high speed fault making motorised grounding switch, stand alone local control SF6 gas monitoring system for complete bay, SF6 bus duct termination arrangement, PO sensor (adequate number of UHF sensors in the offered GIS equipment for detection of partial discharge (of SpC & above) as per IEC 60270 through partial discharge (PD) monitoring system), different gas compartment, O-ring & gaskets, nuts, bolts & washers absorbent limit switch, SF6 gas, etc. to complete line feeder bay module & its earthing arrangement with earthing strips of adequate size as per the technical specification.	245KV, 3150A, 50KA for 3 secs	-	-	04 SETS.	04 SETS.
03	245KV, 3150, 50KA (Specs for busbar, 1 sec for Disconnector, grounding switch & bus PT), 3-phase isolated, SF6 gas insulated, metal enclosed busbars each enclosed in bus enclosures running along the length of the switchgear to interconnect each of circuit breaker bay module. Each busbar sets shall be complete with bus potential transformer (3-Core), disconnectors, bus bar grounding switch, SF6 gas monitoring system PO sensor (adequate number of UHF sensors, SpC & above) as per IEC 60270 through partial discharge (PD) monitoring system), different gas compartment, O-ring & gaskets, nuts, bolts & washers absorbent limit switch, SF6 gas, etc. to complete the bus & its earthing arrangement with earthing strips of adequate size (as per IEEE-80-2000 and OIGRE44 to protect operating staff against any hazardous touch voltages & electro magnetic interferences) as per the technical specification.	245KV, 3150A, 50KA for 3 secs	-	-	02 SETS.	02 SETS.
04	SF6 Gas insulated Bus coupler bay module comprising of SF6 gas insulated circuit breaker, current transformer, disconnectors, switches, disconnector with safety grounding switch(es), Local control cubicle, SF6 gas monitoring system PO sensor (adequate number of UHF sensors in the offered GIS equipment for detection of partial discharge (of SpC & above) as per IEC 60270 through partial discharge (PD) monitoring system), different gas compartment, O-ring & gaskets, nuts, bolts & washers absorbent limit switch, SF6 gas, etc. to complete bus coupler bay module & its earthing arrangement with earthing strips of adequate size (as per IEEE-80-2000 and OIGRE44 to protect operating staff against any hazardous touch voltages & electro magnetic interferences) as per the technical specification.	245KV, 3150A, 50KA for 3 secs	-	-	01 SET.	01 SET.

33kV OUTDOOR EQUIPMENT:

SL.NO.	SYMBOL	DESCRIPTION	RATING	STRUCTURE QUANTITY	EQUIPMENT QUANTITY
01		LIGHTNING ARRESTER	30KV, 10KA, CLASS III, 1-PH	05 NOS.	15 NOS.
02		VACUUM CIRCUIT BREAKER, 3-PH	38KV, 1250A, 31.5KA FOR 3 SEC.	04 NOS.	04 NOS.
03		35KV CURRENT TRANSFORMER FOR TRANSFORMER BAY	35KV, 800-400-200/1A, 5 CORE	03 NOS.	03 NOS.
		35KV CURRENT TRANSFORMER FOR BC & FEEDER BAY	35KV, 800-400-200/1A, 3 CORE	09 NOS.	09 NOS.
04		35KV BUS POTENTIAL TRANSFORMER	35KV, CL.0.2, 50VA, CL.3P, 50VA, 33KV/110V/110V, 5 CORE	03NOS.	03NOS.
05		35KV METERING CURRENT TRANSFORMER FOR FEEDER BAY	35KV, 800-400-200/1A, 5 CORE	06NOS.	06NOS.
06		METERING VOLTAGE TRANSFORMER	35KV, CL.0.2, 50VA, 33KV/110V, 5 CORE	06NOS.	06NOS.
07		STATION TRANSFORMER (OUTDOOR)	250KVA, 33/0.433KV.	02NOS.	02NOS.
08		35KV ISOLATOR	35KV, 1250A, 31.5KA FOR 1 SEC.	08NOS.	08SET
09		35KV ISOLATOR WITH EARTH SWITCH	35KV, 1250A, 31.5KA FOR 1 SEC.	05NOS.	05SET
10		HORN GAP FUSE	30KV, 200A	02NOS.	06NOS.

APPROVED

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08.07.2022

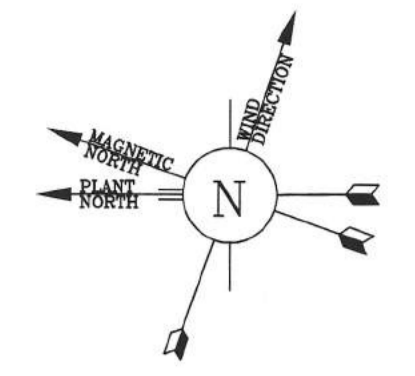
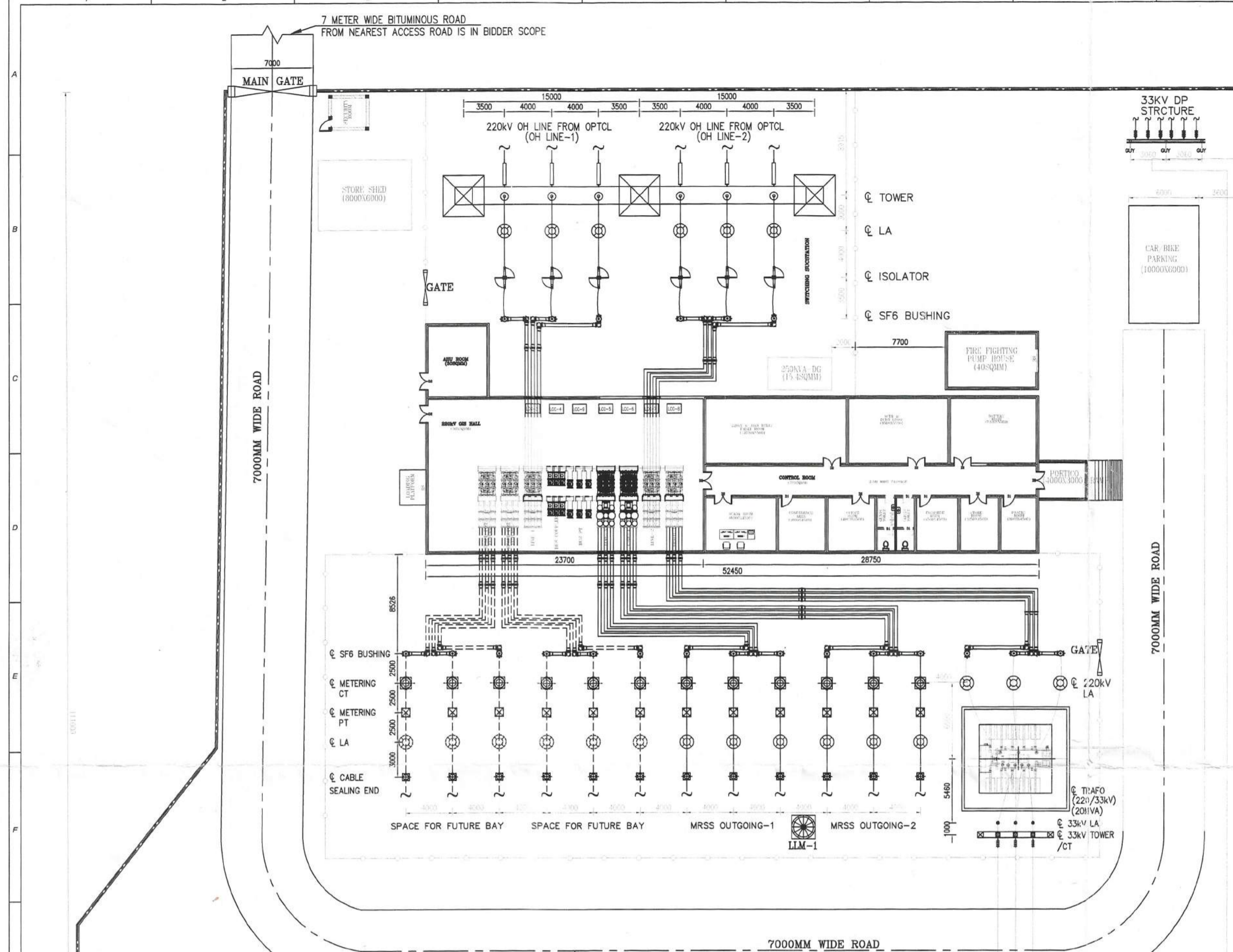
Executive Director
Zonal Office, OPTCL
Bhubaneswar

[Signature]
07.07.2022

Asst. Manager (Elect)
O/o The C.G.M. (O&M)
OPTCL, Bhubaneswar

FOR TENDER PURPOSE

CLIENT:	TALCHER FERTILIZERS LIMITED
PMC:	PTC INDIA LIMITED
PROJECT:	220KV GIS SWITCHING SUBSTATION
DRAWN:	TITLE: 220/33kV GIS SWITCHING S/S SINGLE LINE DIAGRAM
CHECKED:	SCALE: INTS
APPROVED:	DRAWING NO: TFL/PDIL/PTC/SLD-01
DATE:	19.01.2022
REV. DATE DESCRIPTION	SHT NO. REV. 01 01



SYSTEM PARAMETERS

SL.NO.	DESCRIPTION	SYSTEM RATING	
01	NOMINAL SYSTEM VOLTAGE (kV)	220	33
02	HIGHEST SYSTEM VOLTAGE (kV)	245	36
03	BASIC INSULATION LEVEL (kVp) (1.2/50µs)	1050	170
04	1 MIN. POWER FREQUENCY DRY & WET WITHSTAND VOLTAGE (kVrms)	460	70
05	SYSTEM FAULT LEVEL (kA)	50KA FOR 3 SEC.	31.5KA FOR 3 SEC.
06	SYSTEM FREQUENCY (Hz)	50	50
07	NO. OF PHASES	03	03
08	BUS CONFIGURATION	DOUBLE MAIN BUS	SINGLE MAIN & TRANSFER BUS

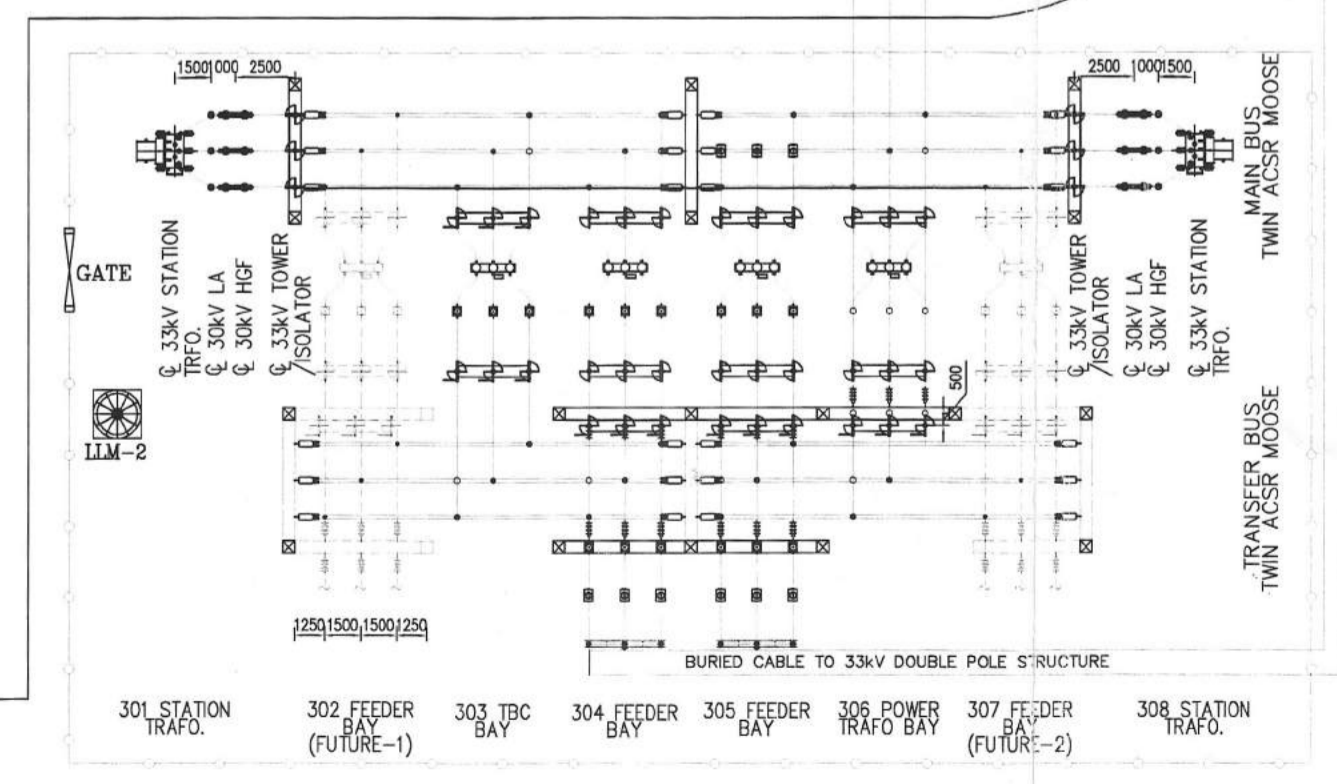
220kV GIS BAYS

S.NO.	DESCRIPTION	UNIT	QTY
01	SF6 GAS INSULATED LINE FEEDER MODULE	SET	04
02	SF6 GAS INSULATED ICT FEEDER MODULE	SET	01
03	SF6 GAS INSULATED BUS COUPLER MODULE	SET	01
04	SF6 GAS INSULATED BUS BAR MODULE	SET	02
05	220kV,SF6 AIR BUSHING	NO'S	15

NOTE:-

1. ALL DIMENSIONS ARE IN MM.
2. 220kV GIS HALL & TRANSFORMER DIMENSIONS SHALL BE FINALIZED DURING DETAILED ENGINEERING.
3. CONTROL ROOM SIZE/ARRANGEMENT SHALL BE FINALIZED DURING DETAILED ENGINEERING.

Space for quarters



- ⊕ 33kV TOWER
- ⊕ 33kV BPI/BUS PT
- ⊕ TOWER/ISOLATOR W/WO ES
- ⊕ 33kV CB
- ⊕ 33kV CT/BPI
- ⊕ 33kV ISOLATOR W/WO ES
- ⊕ 33kV TOWER
- ⊕ 33kV ISOLATOR W 1ES
- ⊕ 33kV BPI
- ⊕ 33kV TOWER/MCT
- ⊕ MPT
- ⊕ LA/CABLE END TERMINATION KIT

APPROVED
[Signature]
 Executive Director
 Zonal Office, OPTCL, BBSR

[Signature]
 Deputy General Manager (Elect.)
 EHT, Construction Circle
 OPTCL, ANGUI

[Signature]
 General Manager (E.I.C.)
 EHT, Construction Circle
 OPTCL, Bhubaneswar

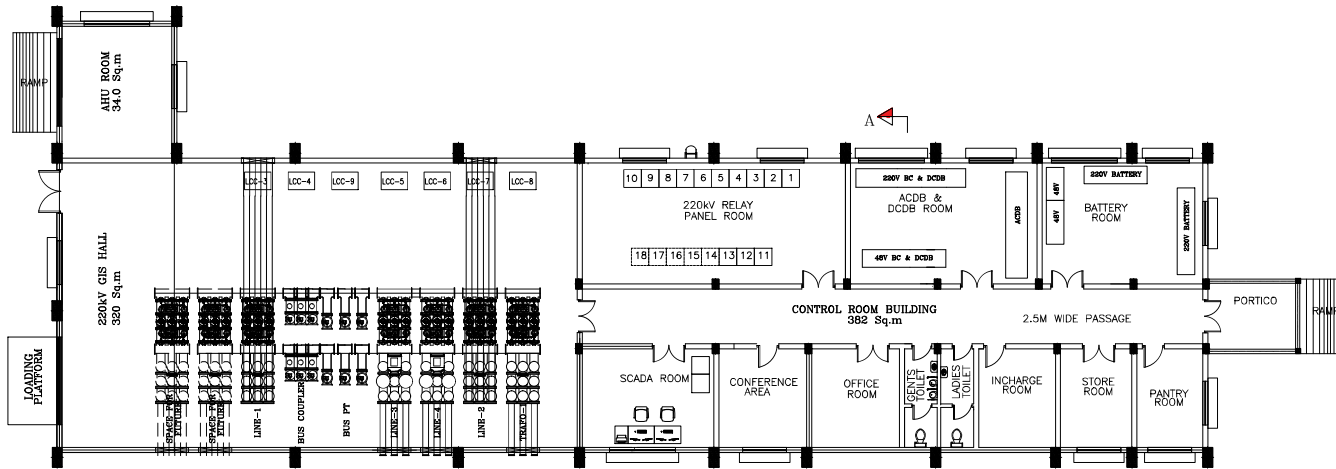
[Signature]
 Dy. General Manager (Project)
 Talcher Fertilizers Limited

[Signature]
 Deputy Manager (E.I.)
 Zonal Office, OPTCL
 Bhubaneswar

PRELIMINARY DRAWING

CLIENT:	TALCHER FERTILIZERS LIMITED
PMC:	PTC INDIA LIMITED
PROJECT:	220KV GIS SWITCHING SUBSTATION
DRAWN:	TITLE: 220/33kV GIS SWITCHING S/S PLAN LAYOUT
CHECKED:	SCALE : 1:300
APPROVED:	DRAWING NO: TFL/PDIL/PTC/PLAN-03
REV. DATE DESCRIPTION	DATE 29.07.2021
	SHT No. REV. 01 01

REV.	DATE	DESCRIPTION
1	25.03.2022	REVISED BASED ON OPTCL COMMENTS WIDE LETTER DT. 16.03.2022
0	29.07.2021	FOR APPROVAL



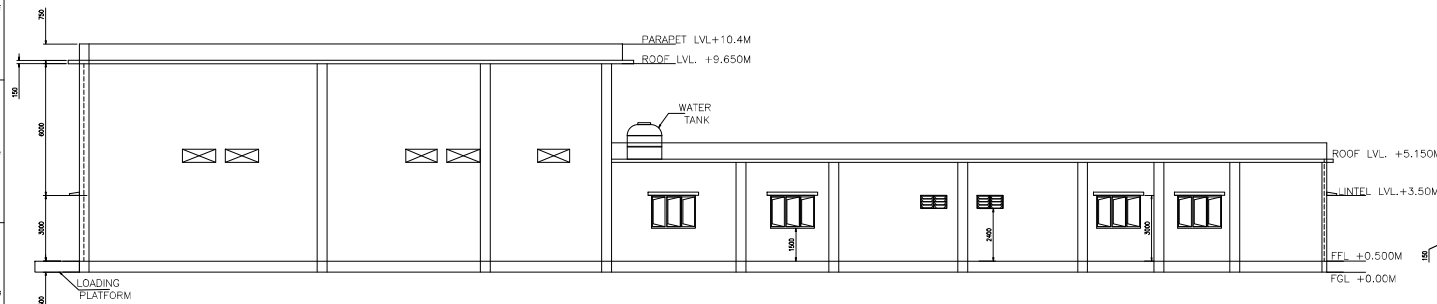
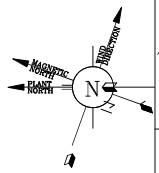
ARCHITECTURAL PLAN

NOTES:

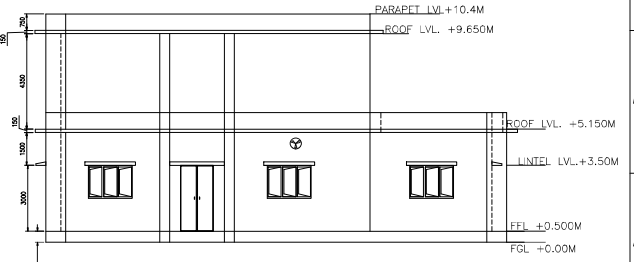
1. ALL DIMENSIONS ARE IN MM & LEVELS IN METRE UNLESS OTHERWISE SPECIFIED.
2. THE DIMENSIONS OF THE EQUIPMENT SHOWN ARE TENTATIVE AND SHALL BE UPDATED AS PER THE EQUIPMENT ACTUAL DIMENSIONS.
3. CUT DETAIL OF PANEL & OTHER EQUIPMENT SHALL SHOWN AFTER RECEIVING GA DRAWING OF RESPECTIVE EQUIPMENT.
4. FINISHED FLOOR LEVEL WILL BE +0.00M.
5. FINISHED FLOOR LEVEL FROM GROUND LEVEL WILL BE +0.50M.

LEGEND:-

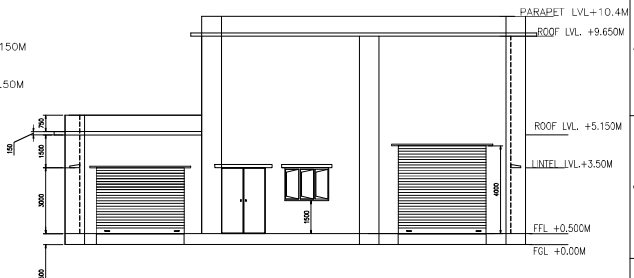
- FGL - FINISHED GROUND LEVEL
- FRL - FINISHED ROAD LEVEL
- FFL - FINISHED FLOOR LEVEL
- TOC - TOP OF CONCRETE LEVEL
- EL - ELEVATED LEVEL



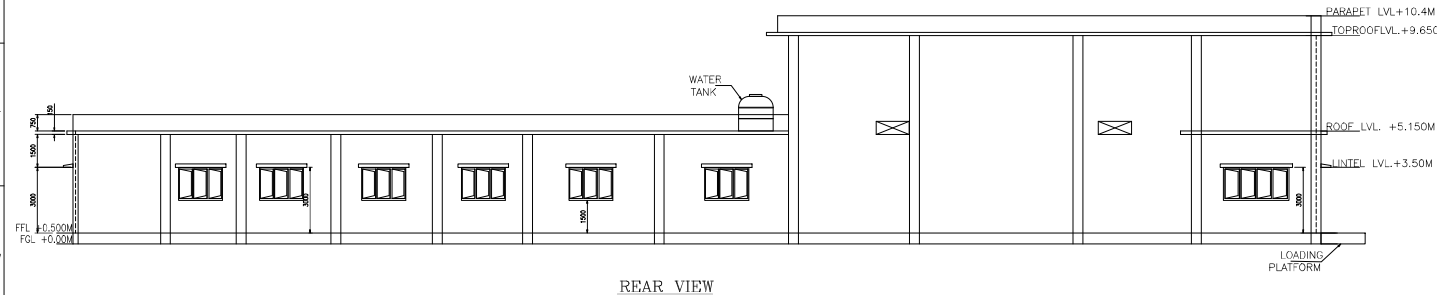
FRONT VIEW



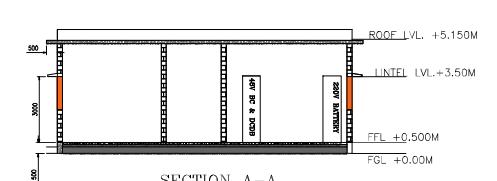
RIGHT VIEW



LEFT VIEW

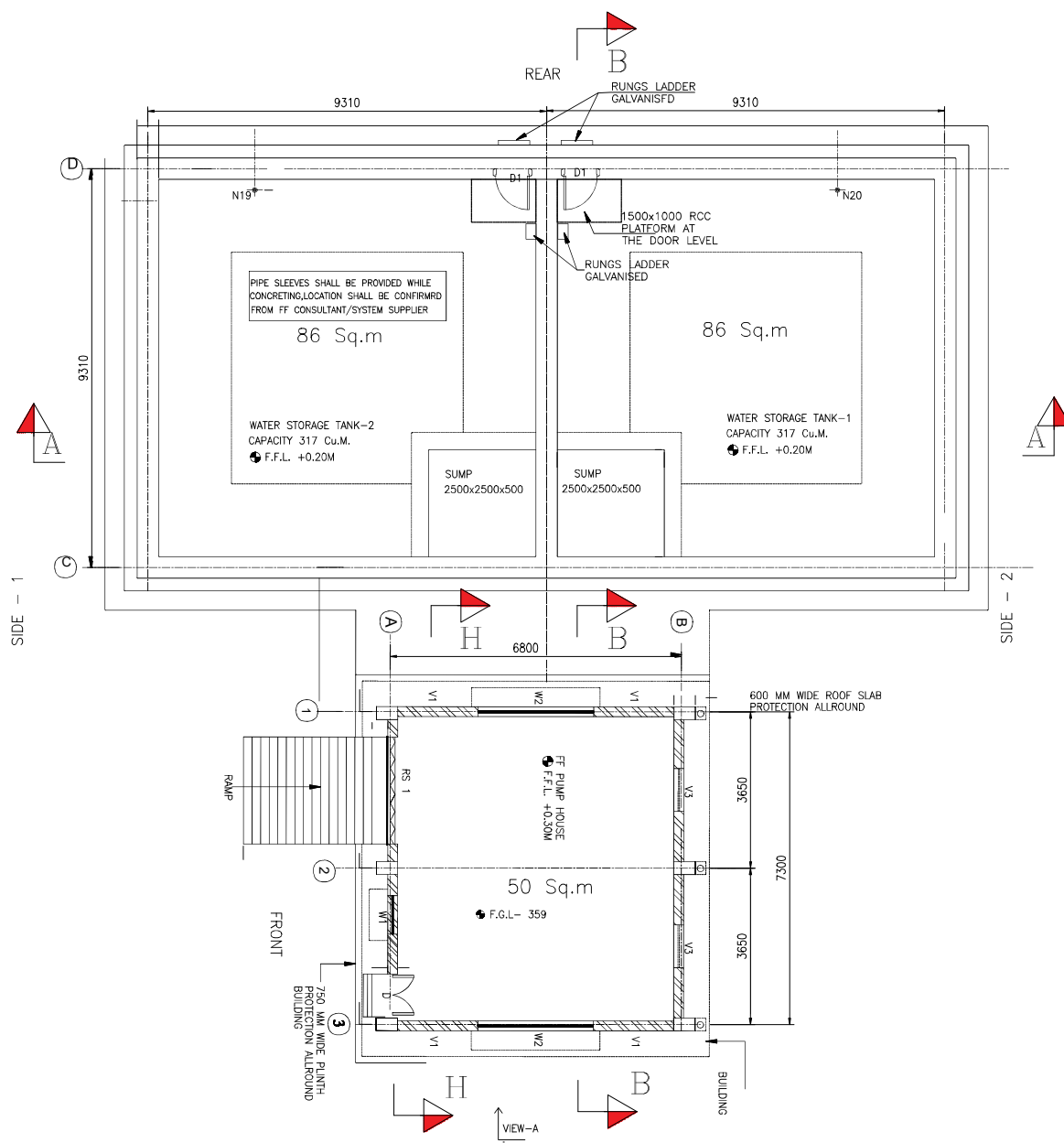


REAR VIEW



SECTION A-A

FOR TENDER PURPOSE ONLY

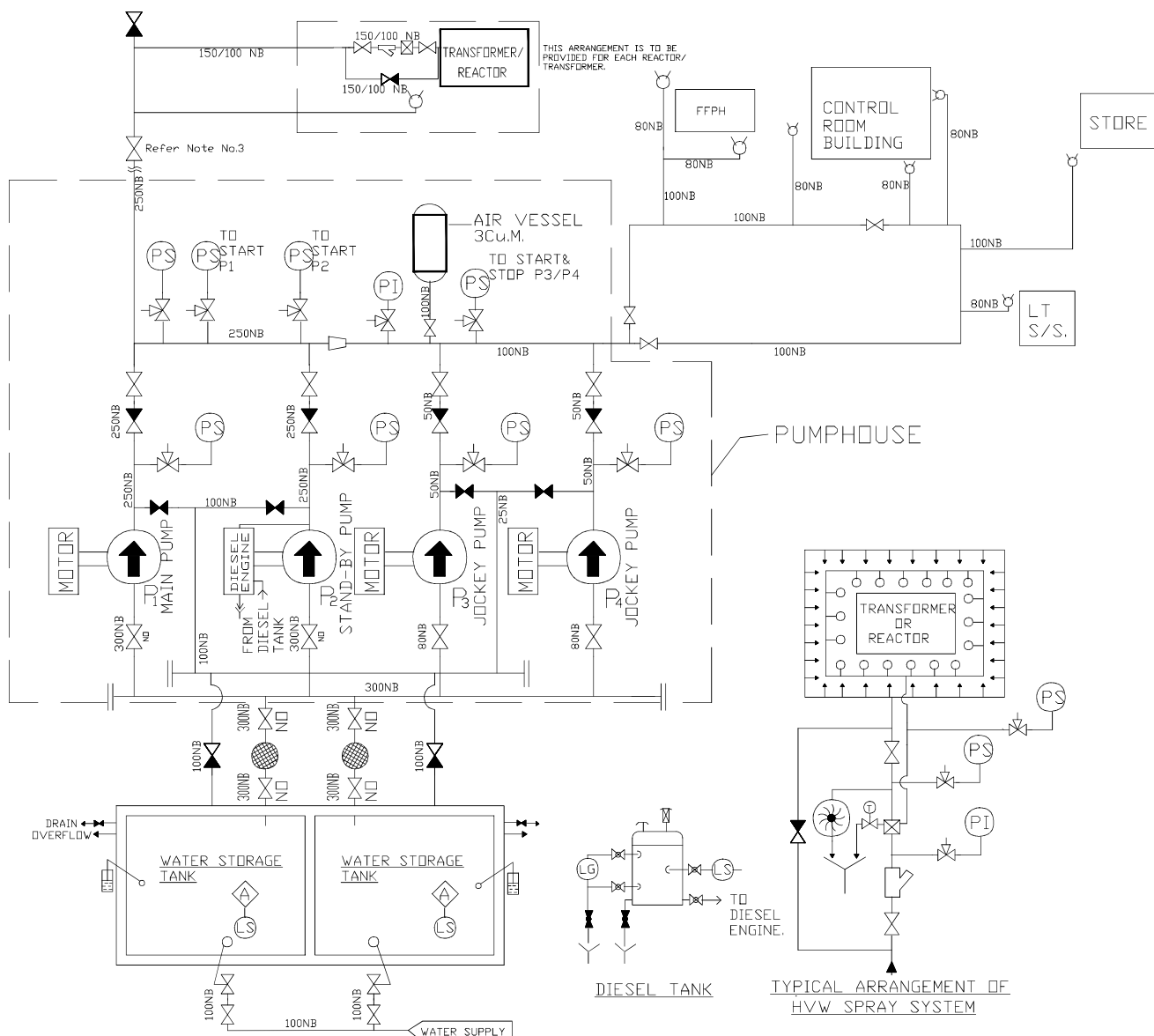


LEGENDS

	BRICK MASONRY
	R.C.C.
	DOOR AND WINDOWS

FOR TENDER PURPOSE ONLY

GROUND FLOOR PLAN FOR FFPH & WATER TANK



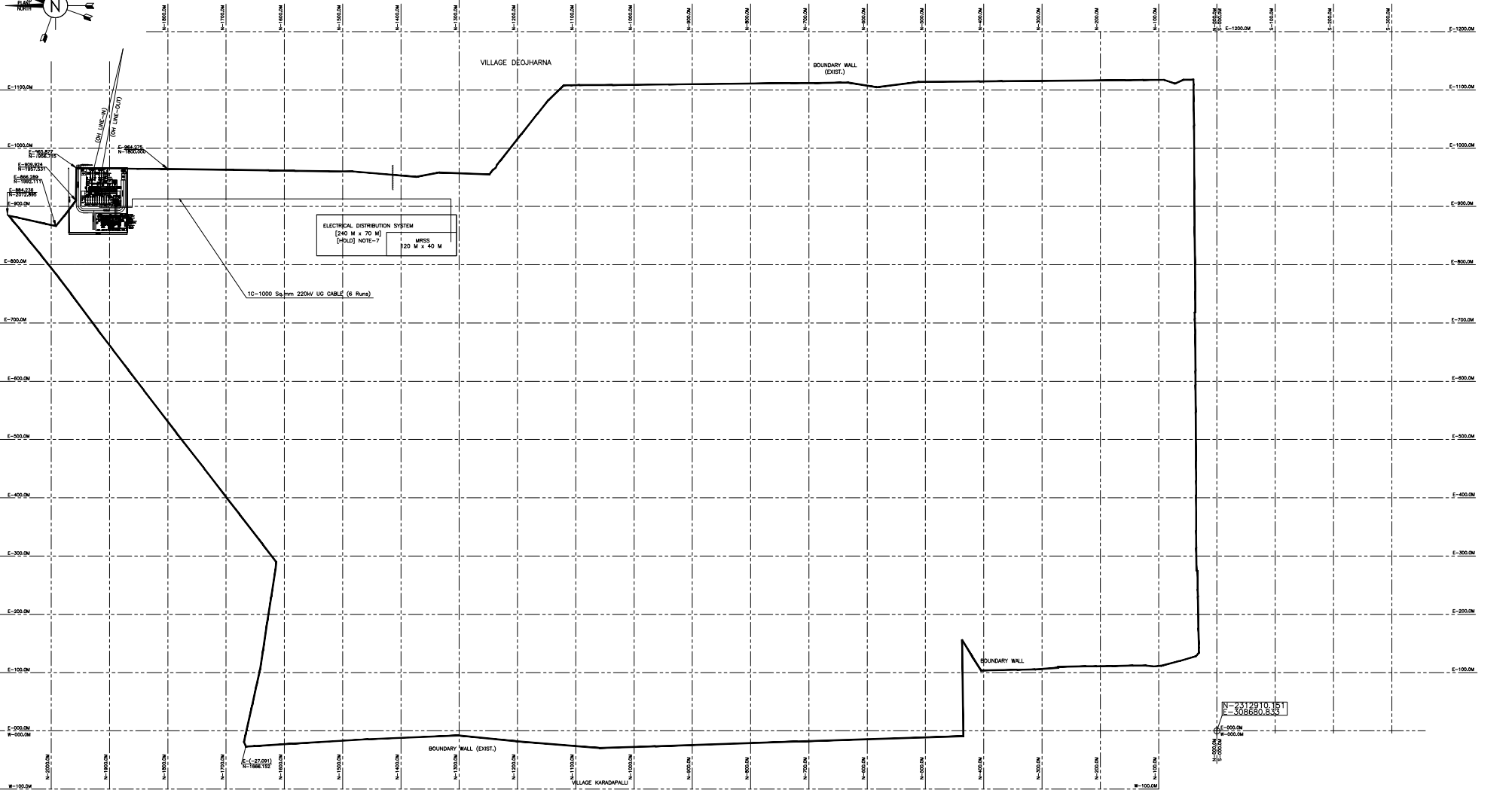
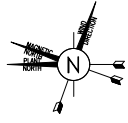
APPENDIX-I
TO TECHNICAL SPECIFICATION
FOR FIRE PROTECTION SYSTEM REV.-6
LEGEND

- ALARM
- GATE VALVE NORMALLY OPEN
- GATE VALVE NORMALLY CLOSED
- NDR-RETURN VALVE
- GLOBE VALVE NORMALLY OPEN
- GLOBE VALVE NORMALLY CLOSED
- FLOAT OPERATED GATE VALVE
- TEST VALVE
- PRESSURE GAUGE
- PRESSURE SWITCH
- LEVEL GAUGE
- LEVEL SWITCH
- BASKET STRAINER
- FLOAT OPERATED LEVEL GAUGE
- Y-TYPE STRAINER
- WATER MOTOR GONG
- REDUCER
- THREE WAY COCK/ VALVE
- VENT
- DRAIN
- OUT DOOR HYDRANT
- QUARTZOID BULB DETECTOR
- HVW SPRAY NOZZLE
- PUMP
- WATER LINE
- DELUGE VALVE

- NOTES:**
1. THE HYDRANT POINTS FOR TRANSFORMER/ REACTOR SHALL BE LOCATED AT LEAST 20M AWAY FROM THEM.
 2. AS SAFETY MEASURE, A WARNING PLATE SHALL BE PLACED NEAR HYDRANT POINTS FOR TRANSFORMER/ REACTOR TO CLEARLY INDICATE THAT WATER SHALL BE SPRAYED ONLY AFTER ENSURING THAT THE POWER TO THE TRANSFORMER/ REACTOR WHICH IS ON FIRE IS SWITCHED OFF AND THERE ARE NO LIVE PART WITHIN 20 M. DISTANCE OF THE PERSONNEL USING THE HYDRANT.
 3. FIRE HYDRANT PIPE LINE OUTSIDE THE PUMP HOUSE SHALL BE SUITABLY SECTIONALIZED AS PER LAYOUT REQUIREMENT. MINIMUM ONE(1) GATE VALVE TO BE PROVIDED FOR EVERY 200 METER OF MAIN HYDRANT PIPE FOR PURPOSE OF MAINTENANCE.

TYPICAL ARRANGEMENT OF HVW SPRAY SYSTEM

FOR TENDER PURPOSE ONLY



ELECTRICAL DISTRIBUTION SYSTEM
 [240 M x 70 M]
 [HOLD] NOTE-7
 M.P.S.S. 220 M x 40 M

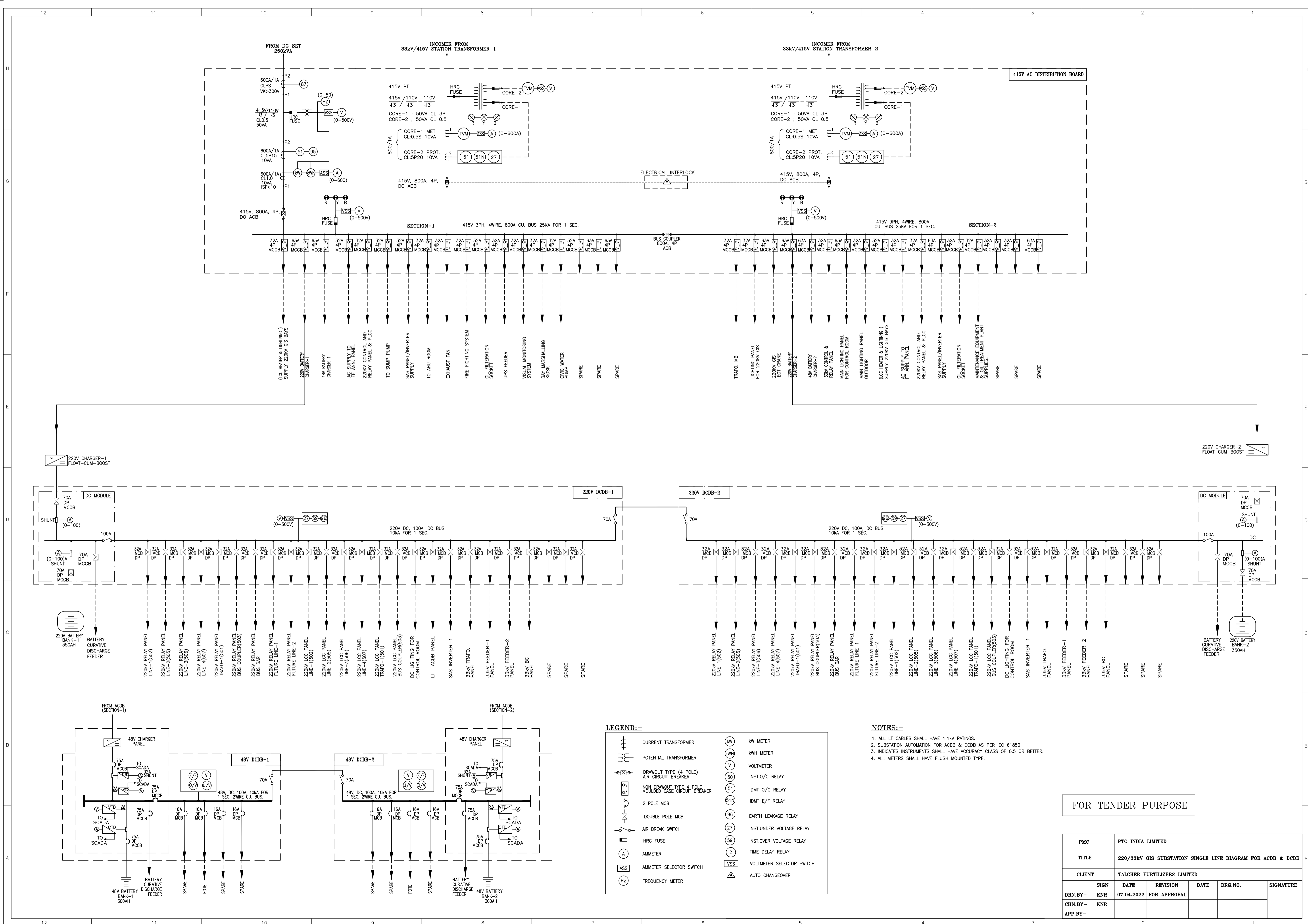
1C-1000 Sq. mm 220KV UG CABLE (6 Runs)

LEGEND :-
 PLANT BOUNDARY
 PROPOSED FACILITIES (P&ID/TEL)

FOR TENDER PURPOSE

CLIENT:	TALCHER FERTILIZERS LIMITED
PMC:	PTC INDIA LIMITED
PROJECT:	220KV GIS SWITCHING SUBSTATION
TITLE:	220/33kV GIS SWITCHING S/S PLOT PLAN LAYOUT
DRAWN:	
CHECKED:	
APPROVED:	
DATE:	
DRAWING NO.:	TFL/PDIL/PTC/PLOT_PLAN
SCALE: -NTS	
SHT NO. REV.	01 00

REV.	DATE	DESCRIPTION



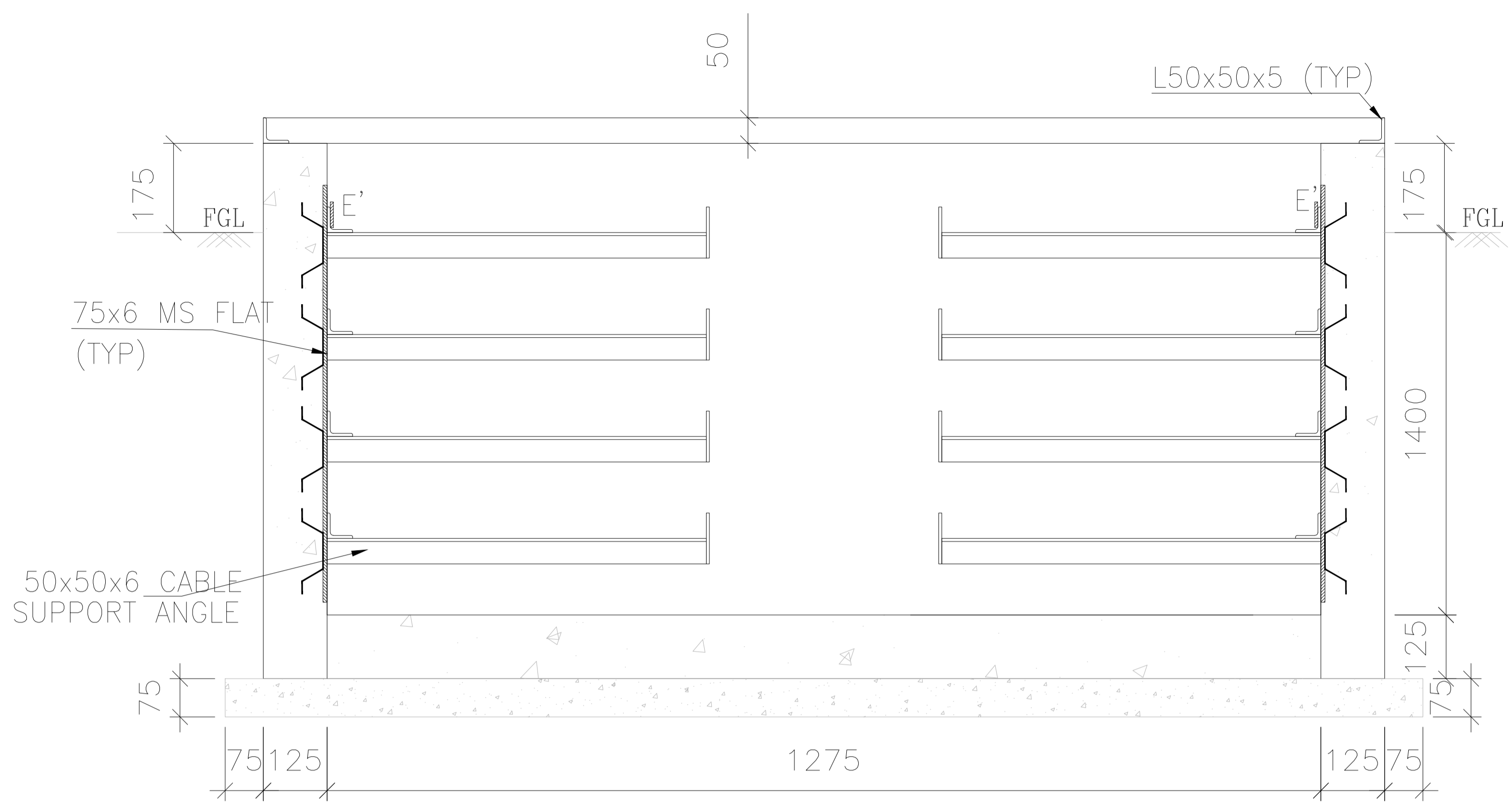
LEGEND:-

	CURRENT TRANSFORMER		KW METER
	POTENTIAL TRANSFORMER		KWH METER
	DRAWOUT TYPE (4 POLE) AIR CIRCUIT BREAKER		VOLTMETER
	NON DRAWOUT TYPE 4 POLE MOULDED CASE CIRCUIT BREAKER		INST.O/C RELAY
	2 POLE MCB		INST.E/F RELAY
	DOUBLE POLE MCB		EARTH LEAKAGE RELAY
	AIR BREAK SWITCH		INST.UNDER VOLTAGE RELAY
	HRC FUSE		INST.OVER VOLTAGE RELAY
	AMMETER		TIME DELAY RELAY
	AMMETER SELECTOR SWITCH		VOLTMETER SELECTOR SWITCH
	FREQUENCY METER		AUTO CHANGEOVER

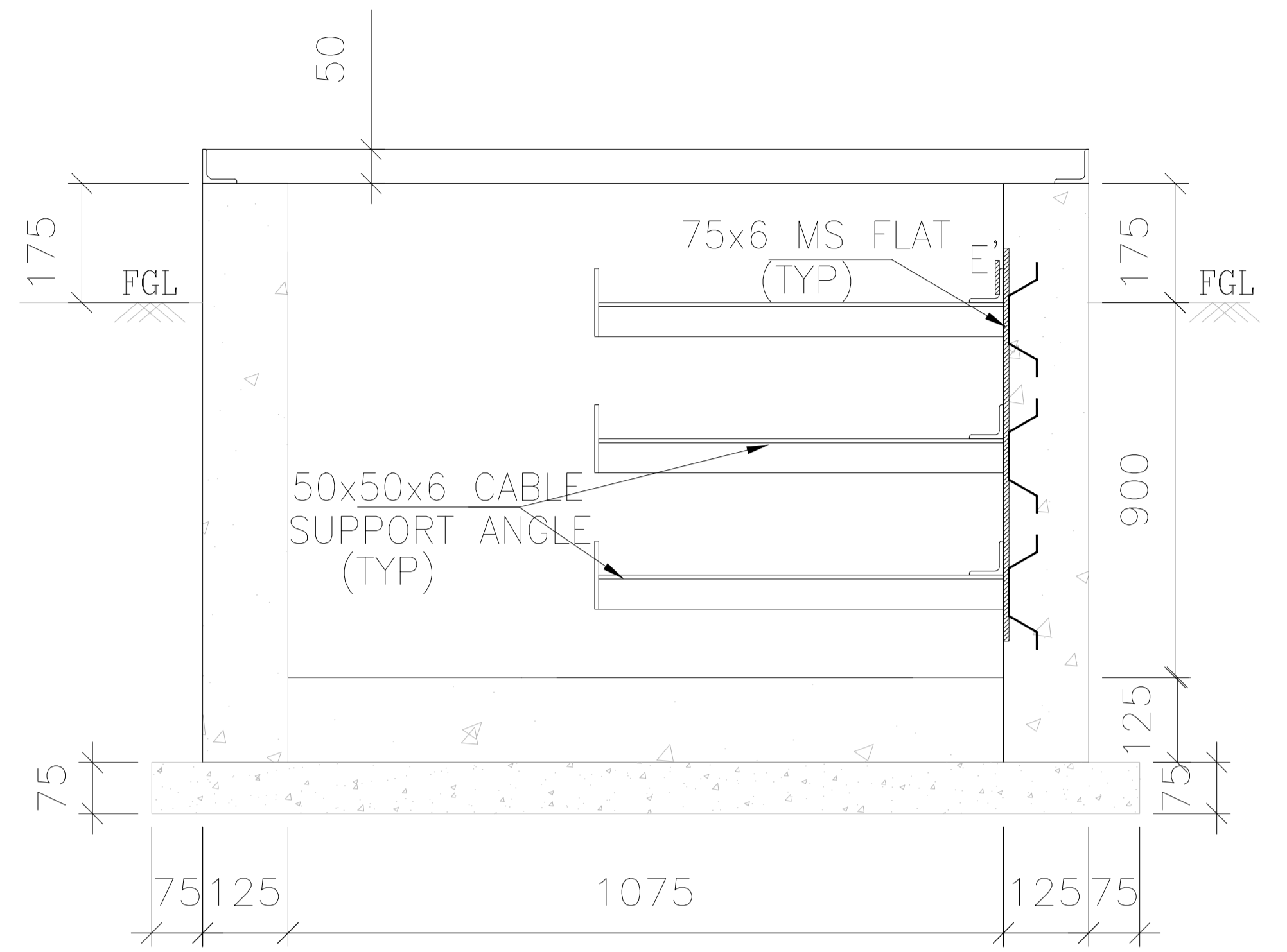
- NOTES:-**
1. ALL LT CABLES SHALL HAVE 1.1kV RATINGS.
 2. SUBSTATION AUTOMATION FOR ACDB & DCDB AS PER IEC 61850.
 3. INDICATES INSTRUMENTS SHALL HAVE ACCURACY CLASS OF 0.5 OR BETTER.
 4. ALL METERS SHALL HAVE FLUSH MOUNTED TYPE.

FOR TENDER PURPOSE

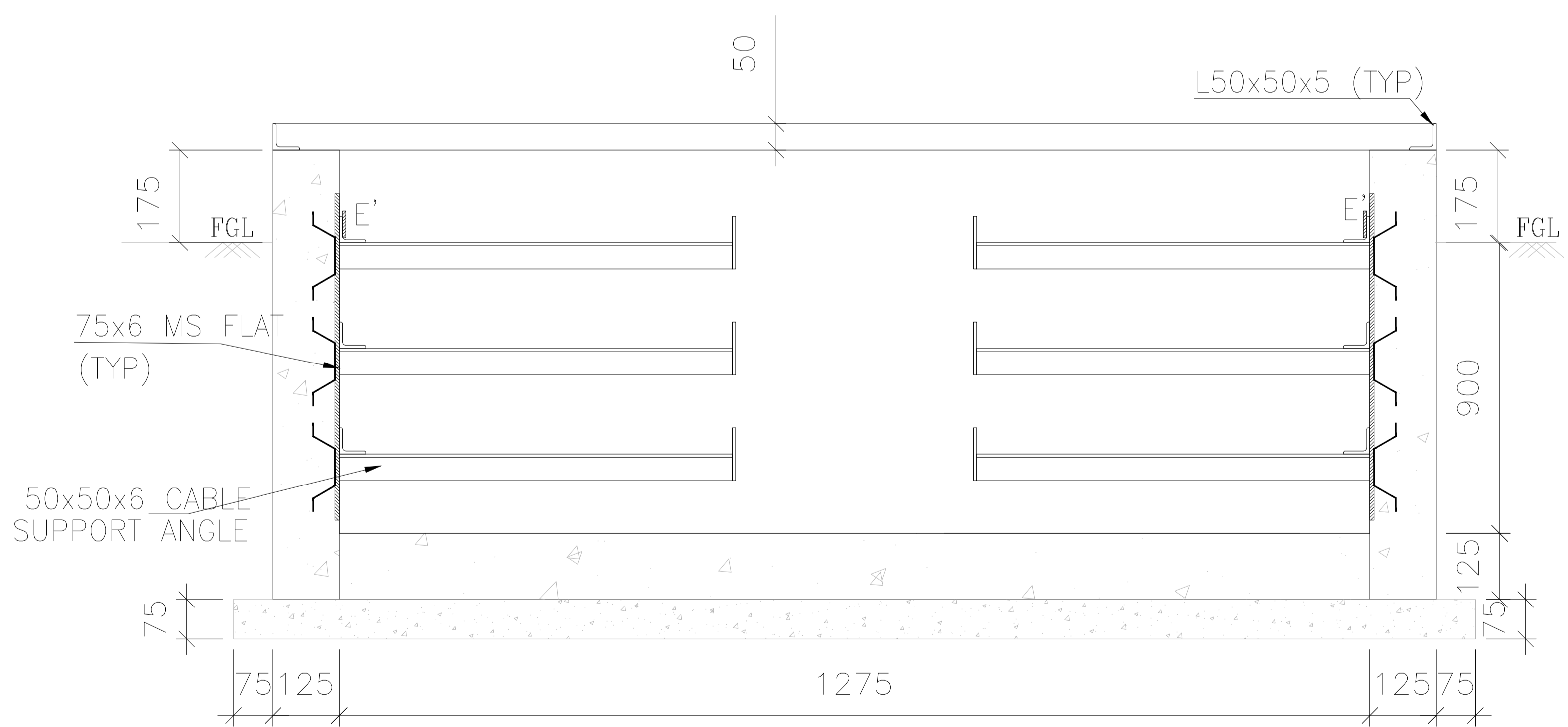
PMC	PTC INDIA LIMITED				
TITLE	220/33kV GIS SUBSTATION SINGLE LINE DIAGRAM FOR ACDB & DCDB				
CLIENT	TALCHER FERTILIZERS LIMITED				
SIGN	DATE	REVISION	DATE	DRG.NO.	SIGNATURE
DRN.BY- KNR	07.04.2022	FOR APPROVAL			
CHN.BY- KNR					
APP.BY-					



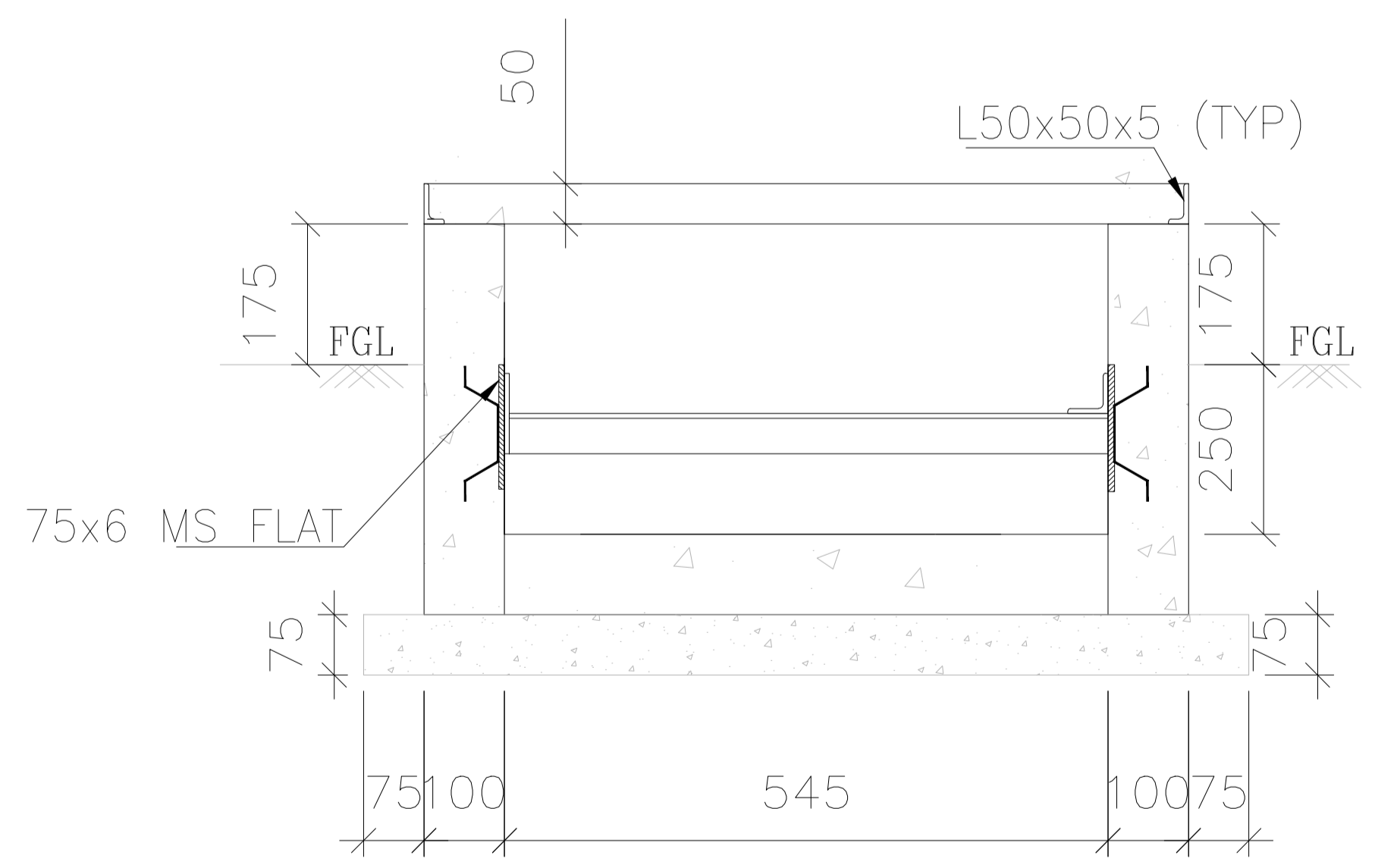
SECTION 1-1



SECTION 3-3



SECTION 2-2



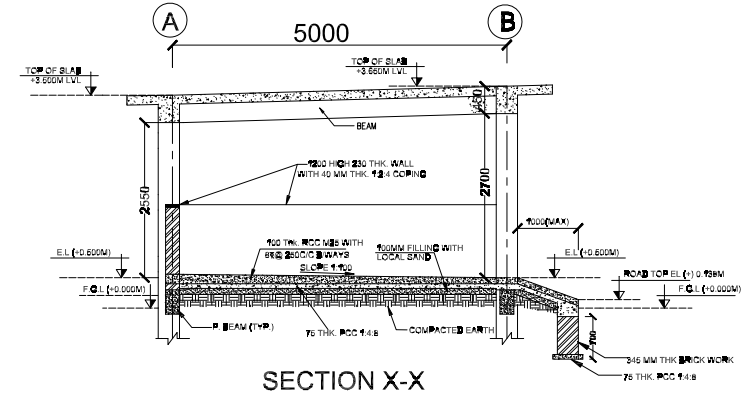
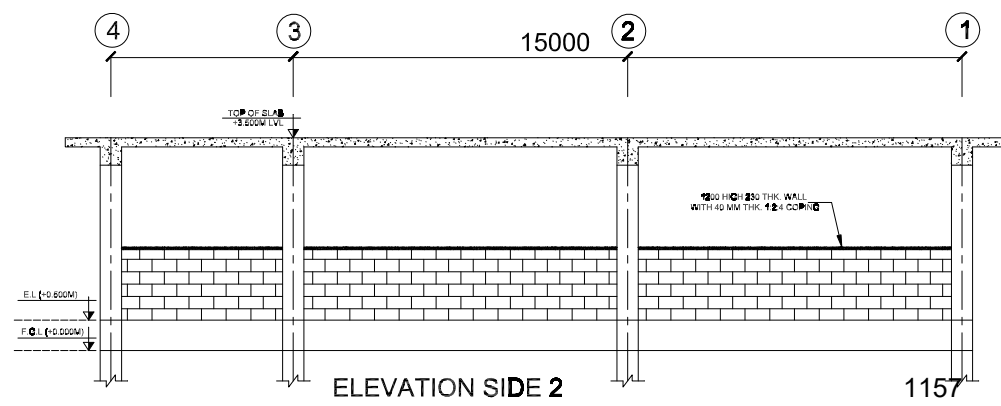
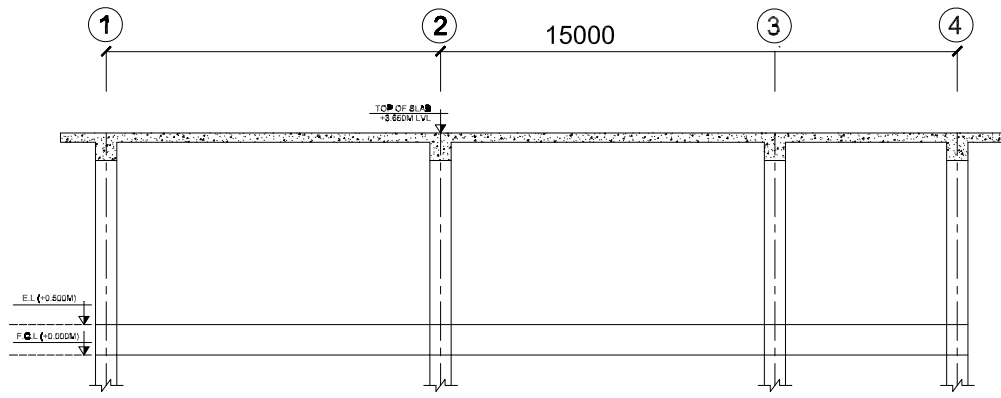
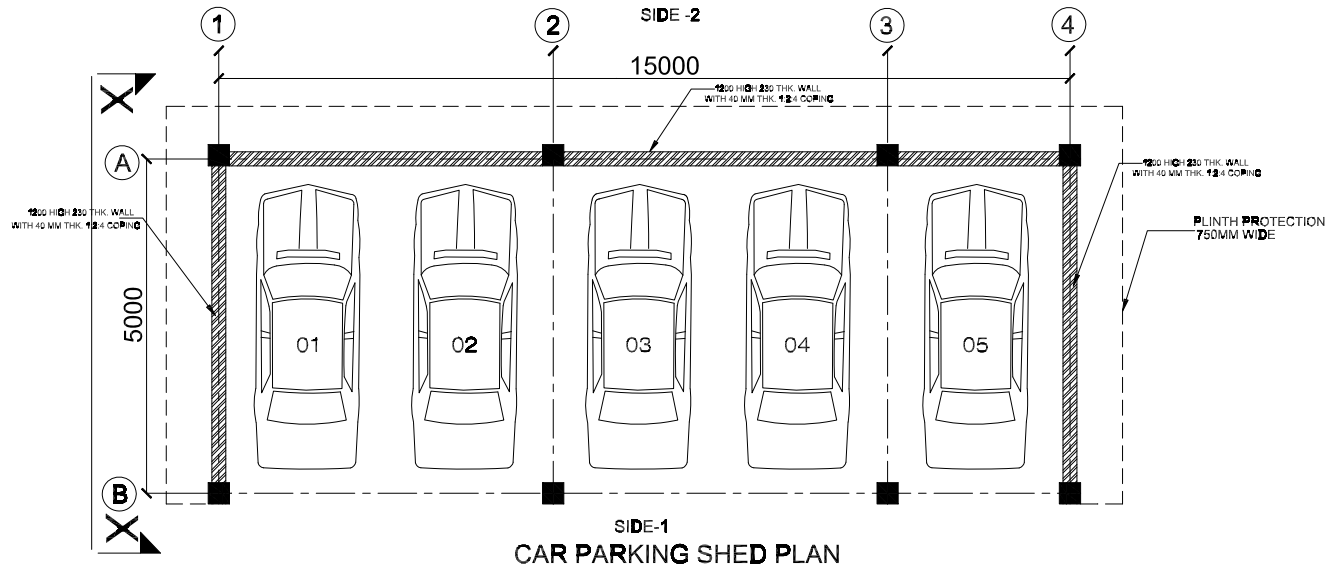
SECTION 4-4

FOR TENDER PURPOSE

TYP. APPROVAL : SIGN & STAMP			
PDS APPROVAL : SIGN & STAMP			
PTC SIGN & STAMP			
		CHECKED	APPROVAL
CLIENT:	TALCHER FERTILIZERS LIMITED		
PWC:	PTC INDIA LIMITED		
PROJECT:	220KV GIS SWITCHING SUBSTATION		
DRAWN:	TITLE: OUTDOOR CABLE TRENCH		
CHECKED:	SCALE: 1:40		
APPROVED:	SHT No. REV		
REV. DATE DESCRIPTION	DATE	TPL/PDIL/PTC/PLAN-06	01 0

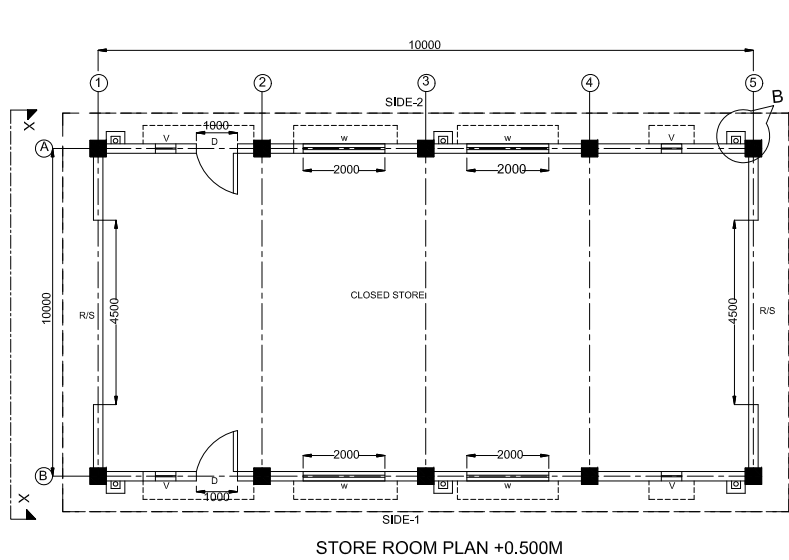
Notes:-

1. ALL DIMENSION ARE IN MM
2. DO NOT SCALE THE DRAWING , FOLLOW WRITTEN DIMENSIONS ONLY.
3. ANY DISCREPANCY TO BE BROUGHT TO THE NOTICE OF SITE INCHARGE
4. DRAWING FOLLOWED ONLY FOR TENDER PURPOSE.
5. TOTAL PARKING LENGTH AND BREADTH = 15MX15M (AREA=225SQ.M)
6. SHED PARKING LENGTH AND BREADTH =15MX5M

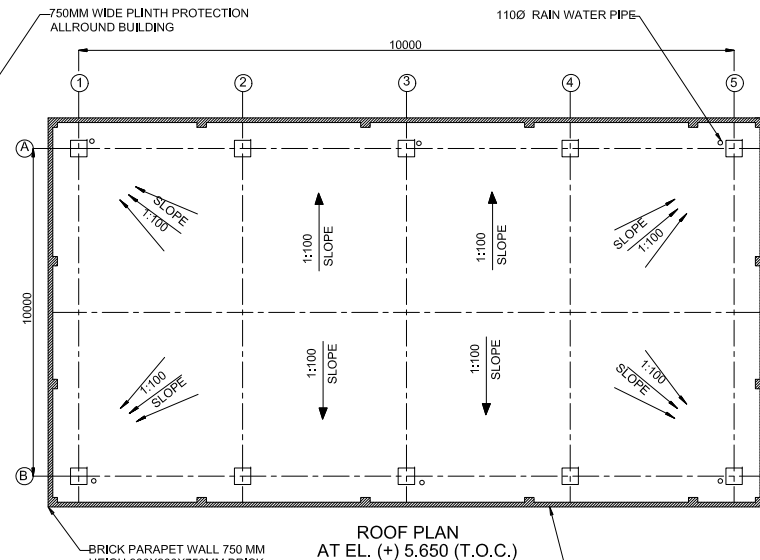


FOR TENDER PURPOSE

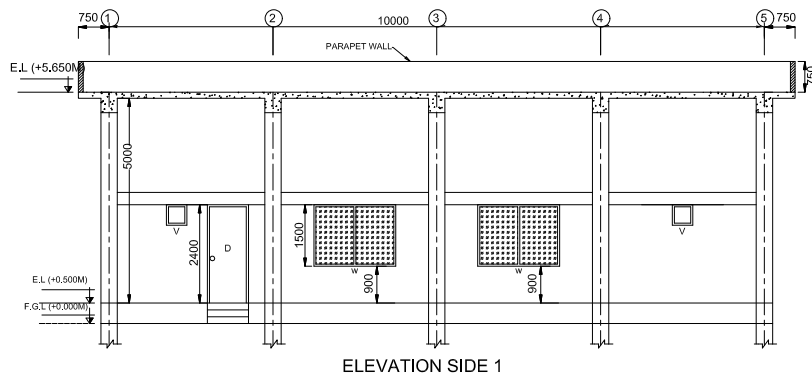
DR. APPROVAL: <input type="checkbox"/> ISS & SEAL PRC. APPROVAL: <input type="checkbox"/> ISS & SEAL PRC. SIGN & SEAL	CHECKED: <input type="checkbox"/> APPROVAL: <input type="checkbox"/> PROJECT: SSDKV 03B SREYCHING REHABILITATION
CLIENT: FALCONER FERTILIZERS LIMITED PRC: SPC SOGA LIMITED	DRAWN: <input type="checkbox"/> DATE: 13.07.2022
TITLE: ASSEMBLING CAR PARKING SHED SCALE: 1:50	DATE: 13.07.2022 DRAWING NO: TPS/PPH/PPC/PLAN-08



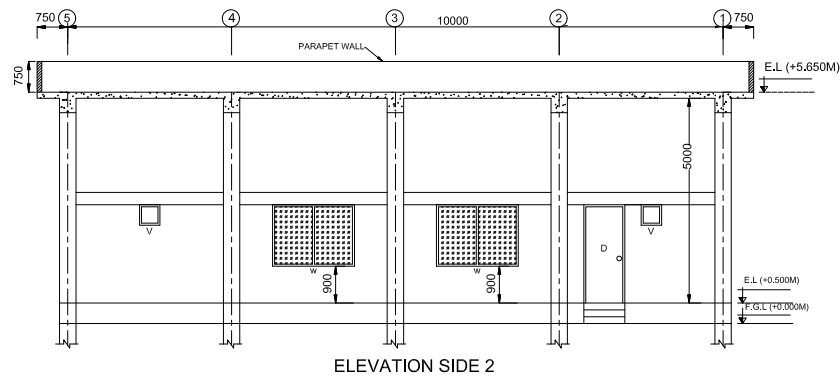
STORE ROOM PLAN +0.500M



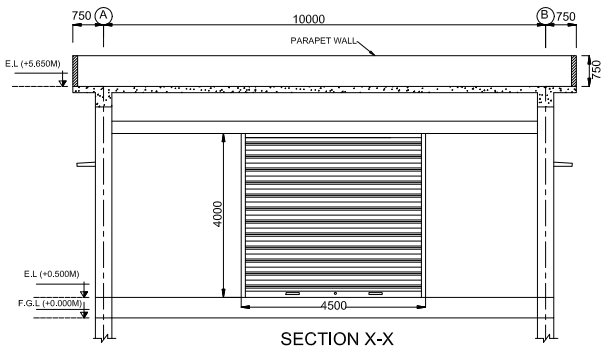
ROOF PLAN AT EL. (+) 5.650 (T.O.C.)



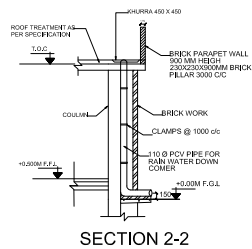
ELEVATION SIDE 1



ELEVATION SIDE 2



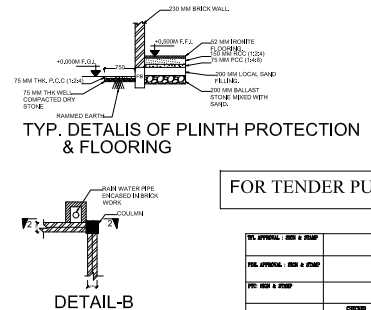
SECTION X-X



SECTION 2-2

- Notes:-**
1. ALL DIMENSIONS ARE IN MM.
 2. DO NOT SCALE THE DRAWING, FOLLOW WRITTEN DIMENSIONS ONLY.
 3. DRAWING FOLLOWED TENDER PURPOSE ONLY.
 4. ANY DISCREPANCY TO BE BROUGHT TO THE NOTICE OF SITE INCHARGE.
 5. TOTAL STORE ROOM LENGTH AND BREADTH = 10MX10M (AREA=100SQ.M)

SCHEDULE OF DOOR & WINDOW						
S/NO	NAME	WIDTH	HEIGHT	SILL LEVEL WR. TO FFL	LINTEL LEVEL WR. TO FFL	DESCRIPTION
1.	ROLLING SHUTTER (RS)	4500	4000	—	4.000 M	02 MS ROLLING SHUTTER
2.	WINDOW (W)	2000	1500	0.900 M	2.400 M	04 MS FRAME WINDOW WITH 10 MM SQ. BAR GRILLS AND 5.5 mm THK. GLASS GLAZING.
3.	VENTILATOR (V)	500	500	1.800 M	2.400 M	04 MS VENTILATOR WITH 5.5 mm THK. GLASS GLAZING.
4.	DOOR (D)	1000	2400	—	2.400 M	02 FLUSH DOOR SHUTTERS (IS 100) WITH COMMERCIAL P.V.C. GEL PAINTED SHALL BE PROVIDED.

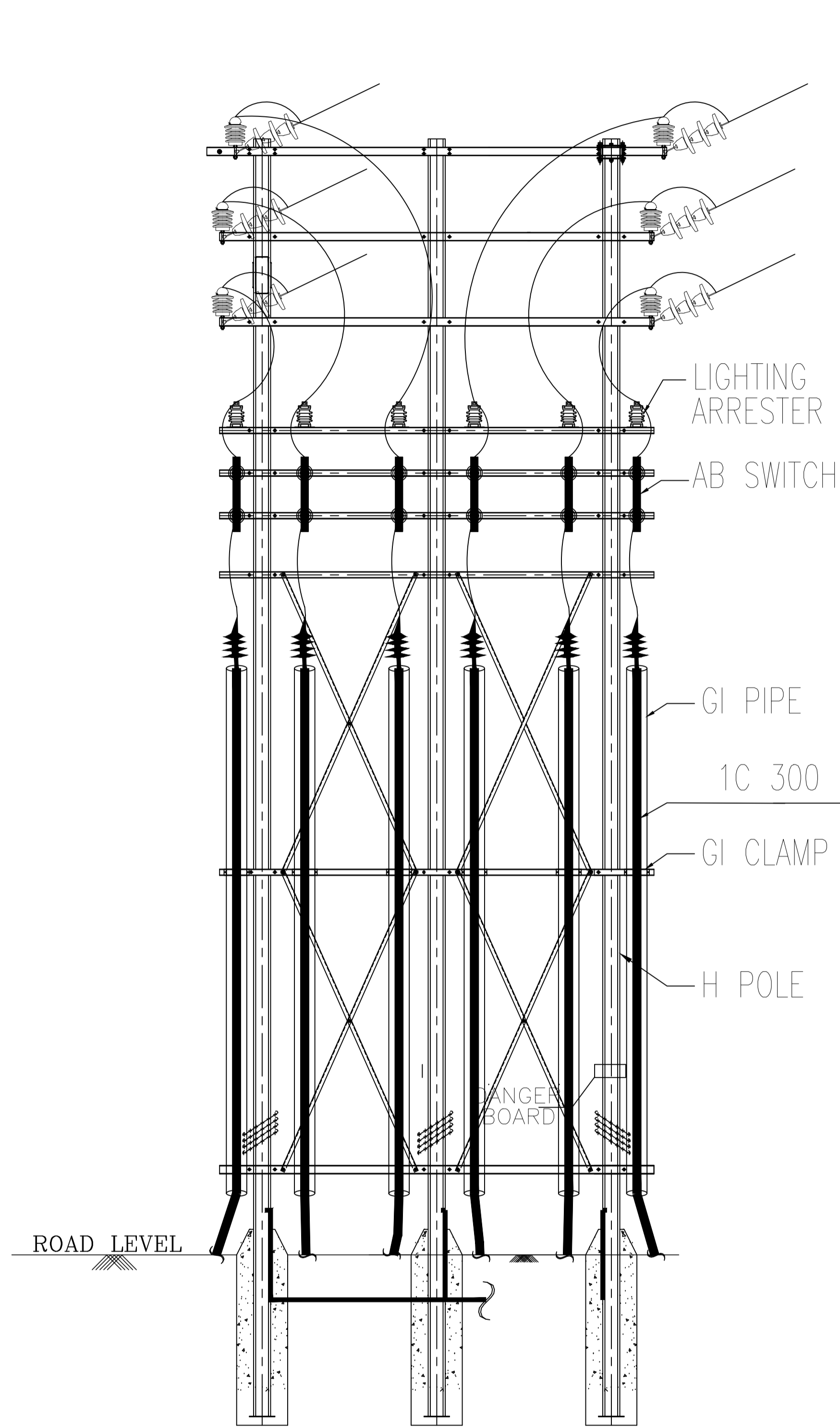


DETAIL-B

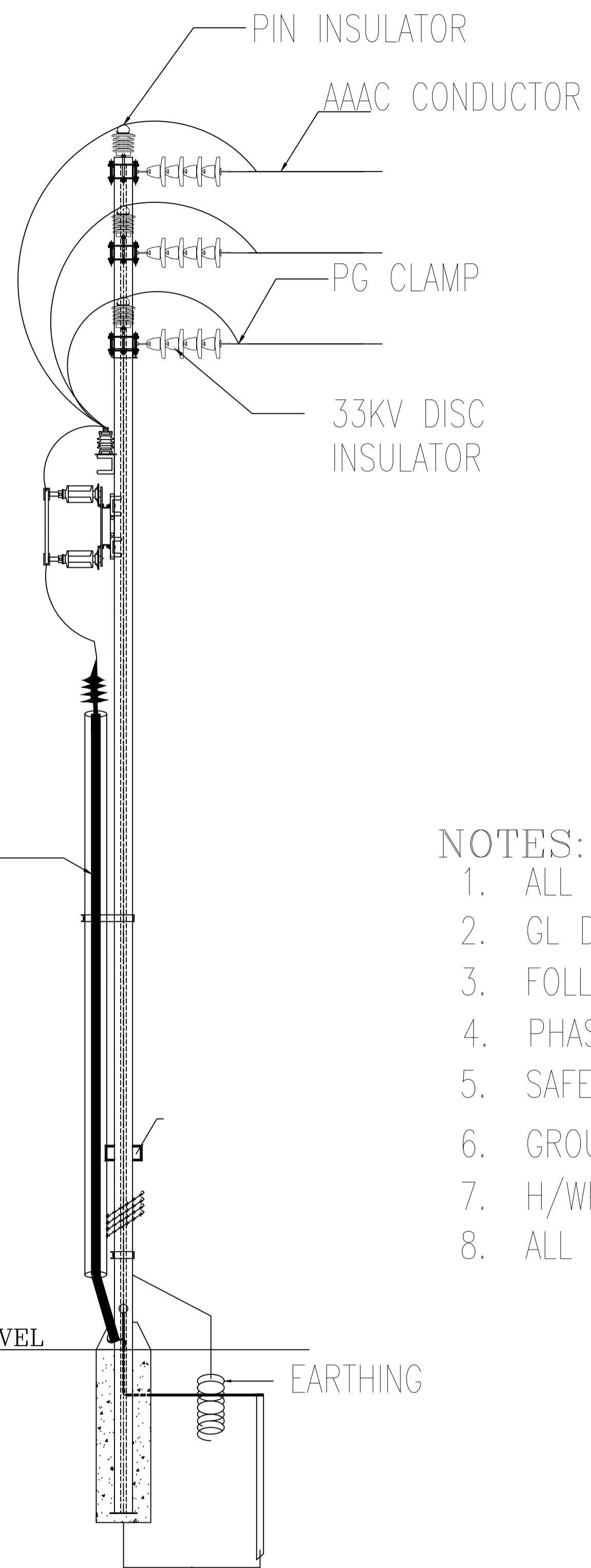
FOR TENDER PURPOSE

DRW. NO. & DATE		DATE	
1	13.07.2022	FOR TENDER	
REV	DATE	DESCRIPTION	

NO.	DATE	DESCRIPTION
1	13.07.2022	FOR TENDER
2	13.07.2022	FOR TENDER



ELEVATION



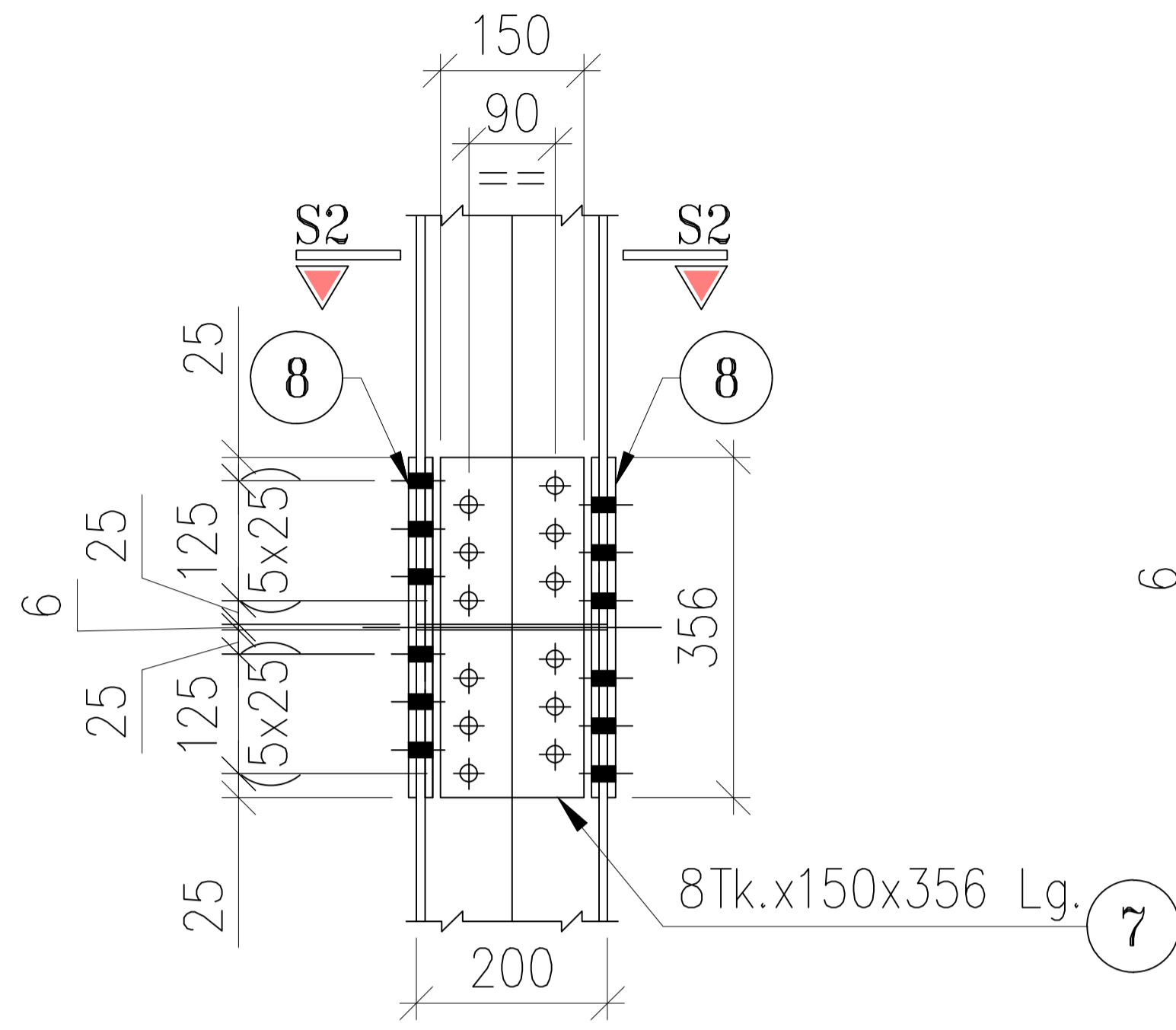
SECTION

TENDER PURPOSE ONLY

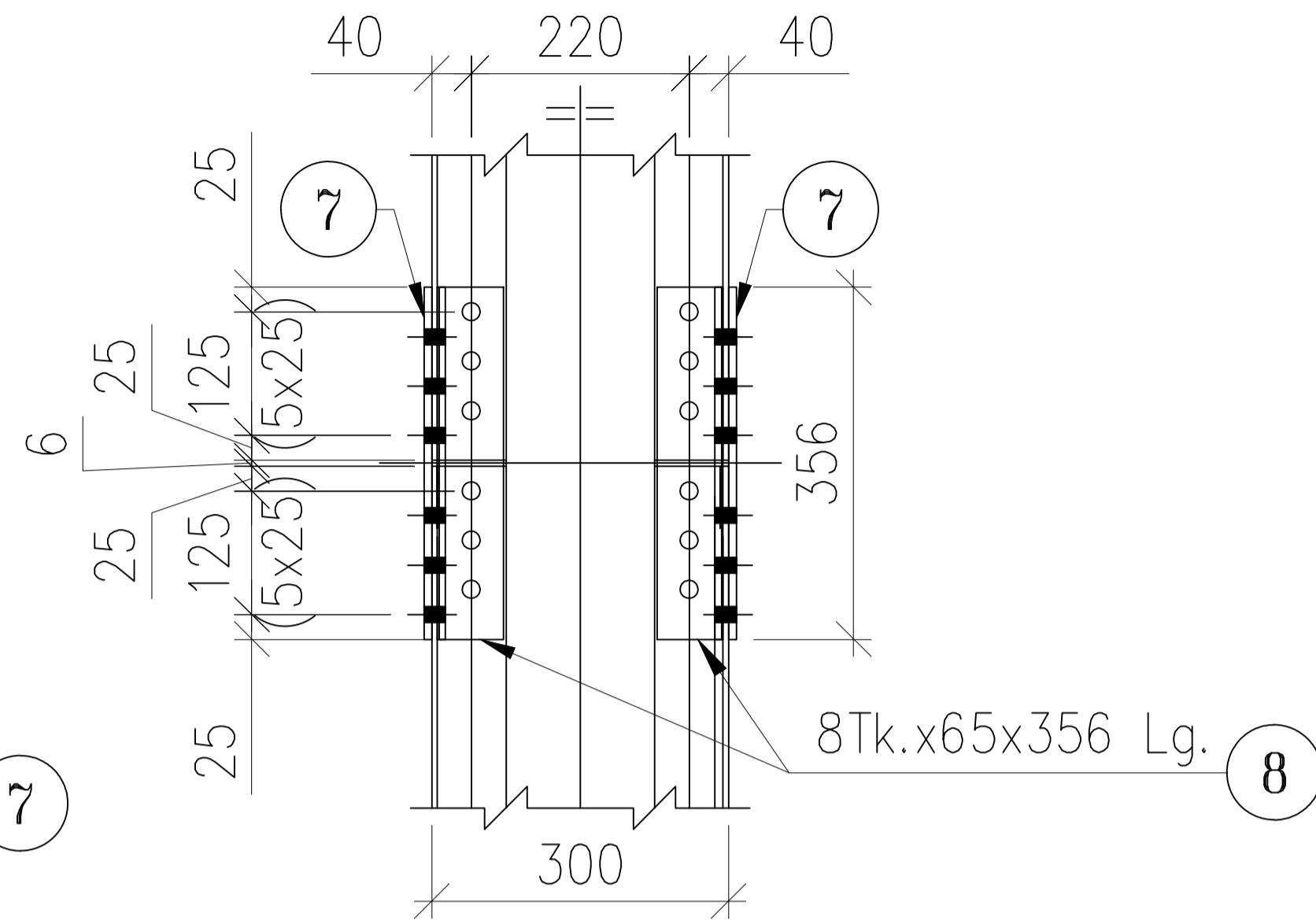
NOTES:

1. ALL DIMENSION ARE IN MM.
2. GL DENOTES GROUND LEVEL
3. FOLLOWING MINIMUM CLARENCE SHALL BE MAINTAINED FOR 33KV SYSTEM.
4. PHASE TO PHASE : 320 MM
5. SAFETY WORKING CLARENCE (SECTIONAL CLARENCE) : 3000 MM. minimum
6. GROUND CLARENCE : 3700 MM. minimum
7. H/WPB POLES SHALL BE EARTHED THROUGH COIL EARTH USING S.W.G 8MM GI WIRE
8. ALL CHANNEL AND ANGLE SHALL BE GALVANIZED AS PER TECHNICAL SPECIFICATION.

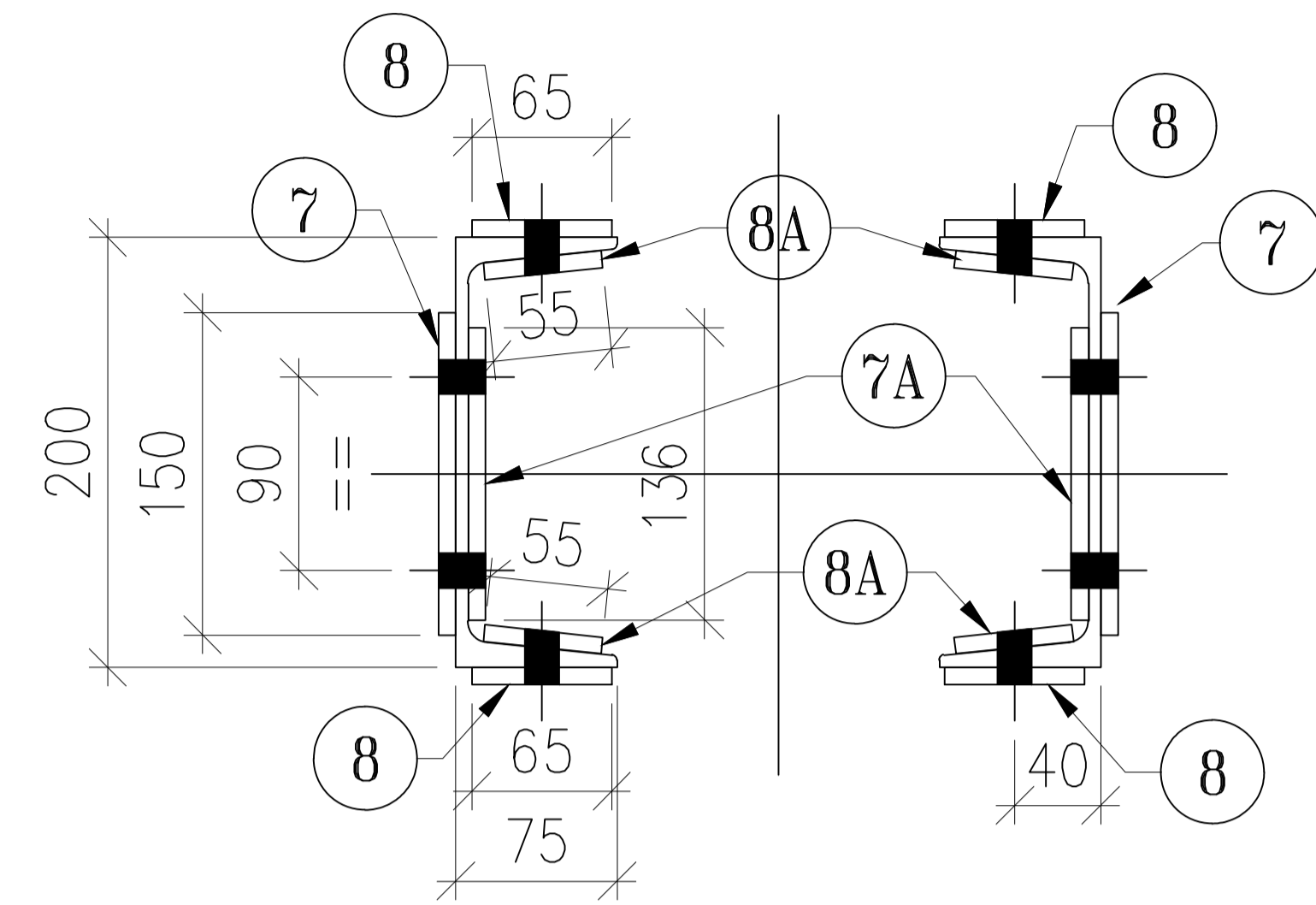
CLIENT:		TALCHER FERTILIZERS LIMITED	
PMC:		PTC INDIA LIMITED	
PROJECT:		220KV GIS SWITCHING SUBSTATION	
DRAWN:	TITLE:	CABLE TERMINATION LINE TAKE OFF ARRANGEMENT	SCALE: 1:100
CHECKED:	DATE:	13.07.2022	01
APPROVED:	DATE:	13.07.2022	01
REV.	DATE	DESCRIPTION	TFL/PDIL/PTC/SECTION-07



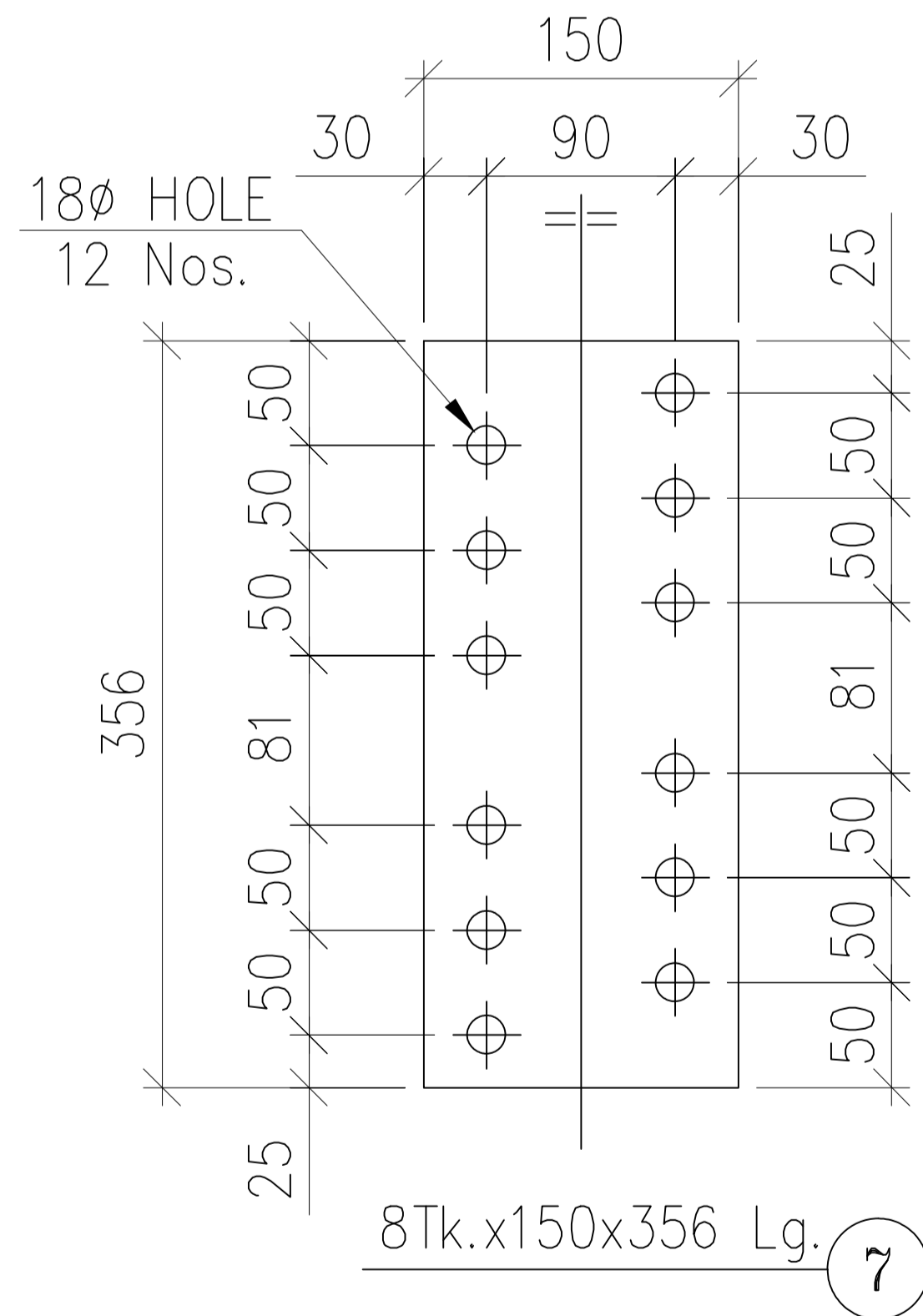
DETAIL-D1



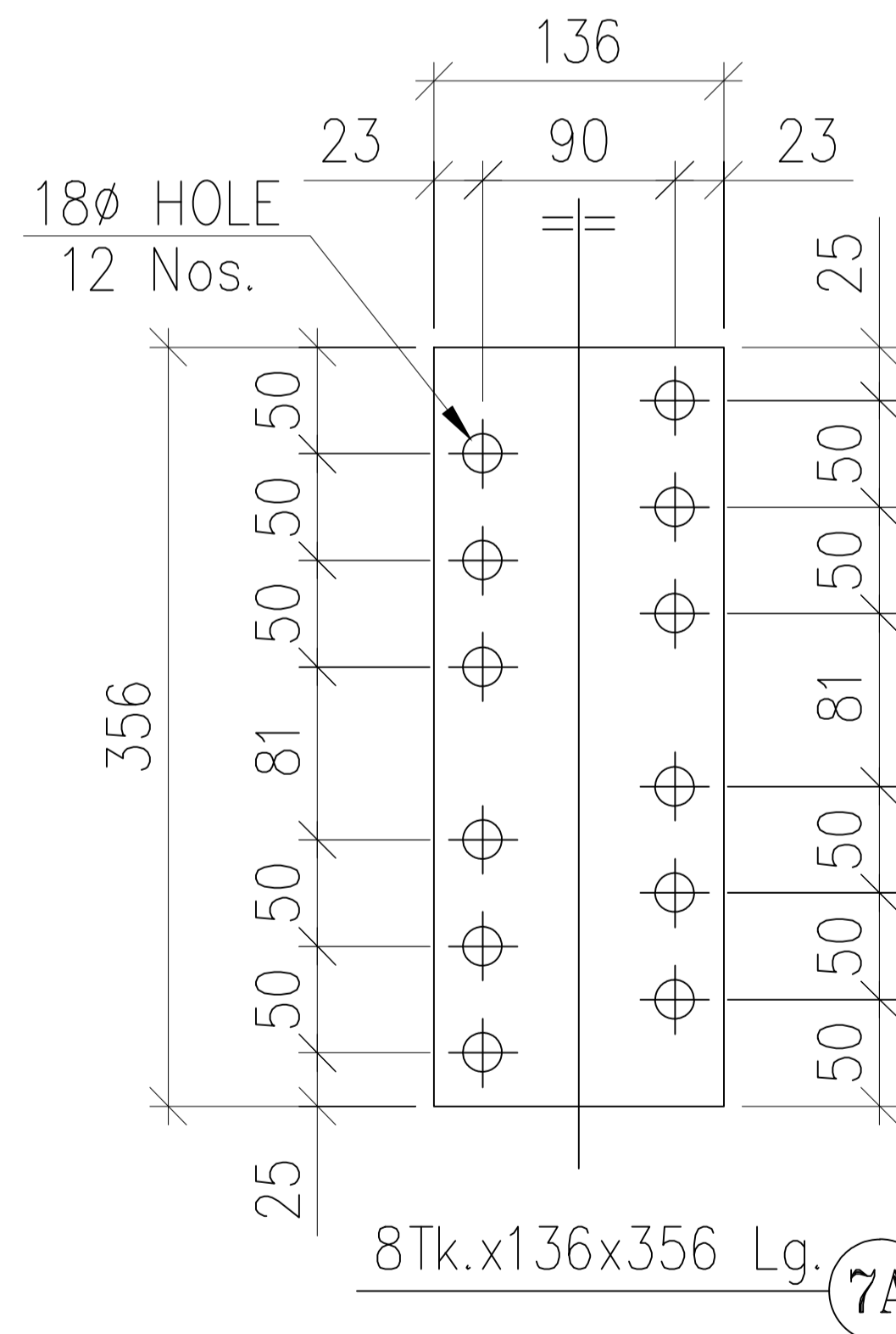
DETAIL-D2



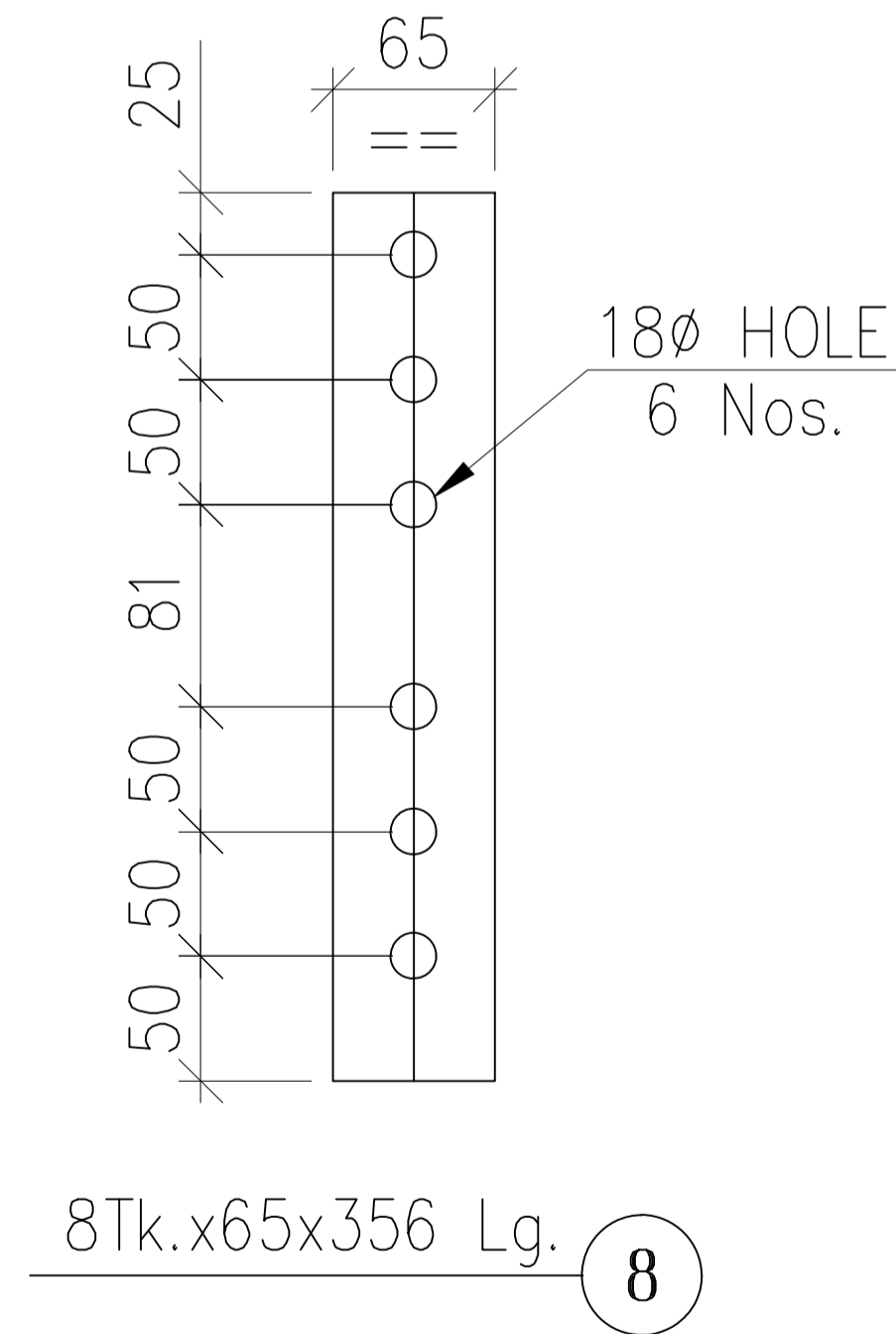
SECTION S2-S2



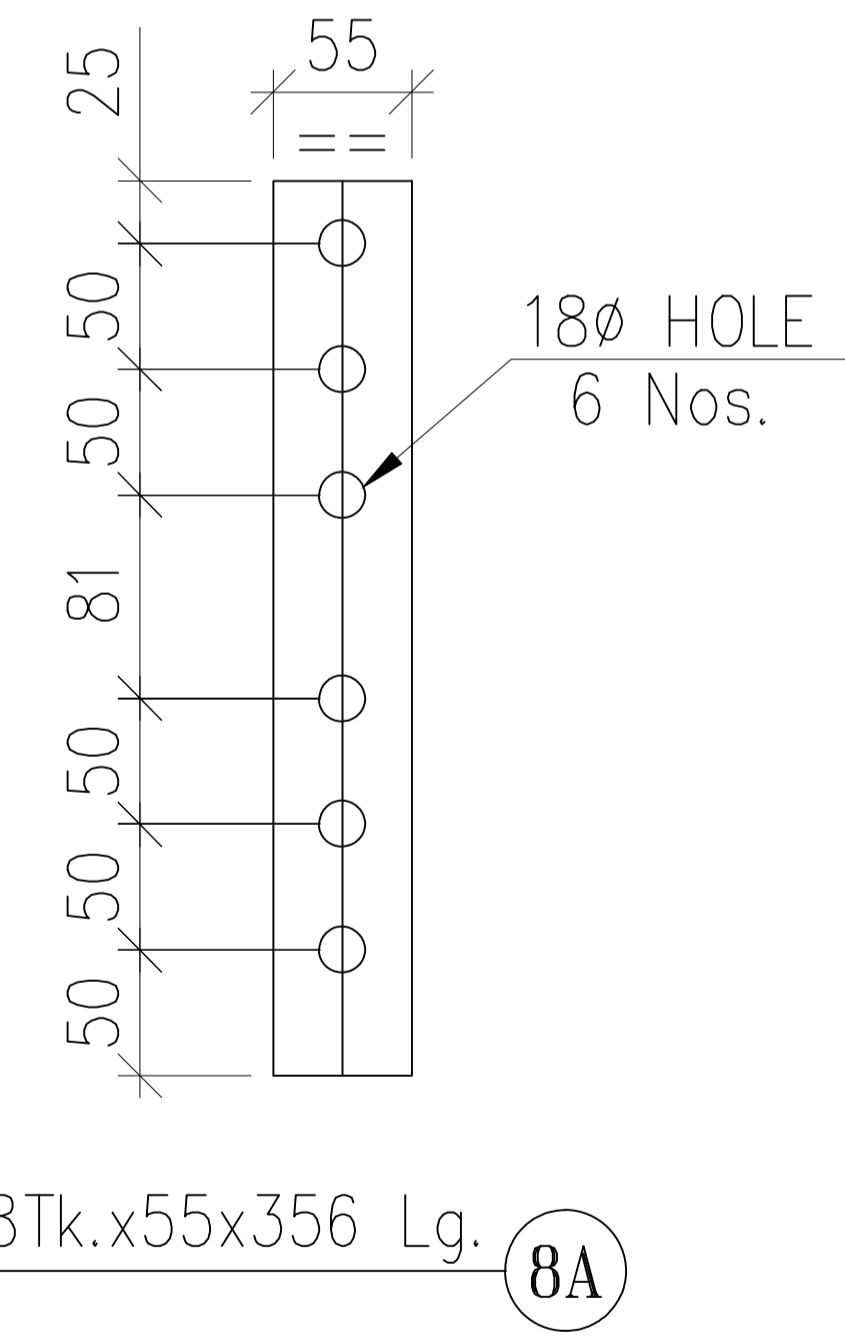
8Tk.x150x356 Lg. (7)



8Tk.x136x356 Lg. (7A)



8Tk.x65x356 Lg. (8)



8Tk.x55x356 Lg. (8A)

TENDER PURPOSE ONLY

CLIENT: TALCHER FERTILIZERS LIMITED	
PMC: PTC INDIA LIMITED	
PROJECT: 220KV GIS SWITCHING SUBSTATION	
DRAWN:	TITLE: 14 WBS: H POLE STRUCTURE
CHECKED:	SCALE: 1:40
APPROVED:	DRAWING NO: TPL/PDIL/PTC/H POLE-10
REV. DATE DESCRIPTION	DATE 13.07.2022
	SHEET NO: 01