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SECTION VI

TECHNICAL INDEX

COAL/PETCOKE/LIMESTONE HANDLING FROM RAILWAY SIDING TO STORAGE YARD

NIT NO- PNMM/PC183/E-4018/NCB

**PROJECT: INTEGRATED COAL BASED FERTILISER
COMPLEX, AT TALCHER, ANGUL DISTRICT,
ODISHA (INDIA)**

0	14.03.23	14.03.23	ISSUED FOR TENDER	AKS	AKS/NS	NS
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SECTION VI – 1.0

PROJECT DESCRIPTION

COAL/PETCOKE/LIMESTONE HANDLING FROM RAILWAY SIDING TO STORAGE YARD

**PROJECT: INTEGRATED COAL BASED FERTILIZER
COMPLEX, AT TALCHER, ANGUL DISTRICT,
ODISHA (INDIA)**

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1.0 INTRODUCTION:

Talcher Fertilizers Ltd. (TFL), herein after also referred to as “OWNER” A joint venture company of four major Public Sector Units – M/s GAIL (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 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 on LSTK basis for handling of coal / Petcoke / limestone from Railway siding to storage yard through wagon tippler, Track Hopper and associated belt conveyor etc.

Projects & Development India Ltd. (PDIL) has been retained by M/s Talcher Fertilizers Limited as Project Management Consultant for selection of a suitable LSTK Contractor for execution of the project on a Lump-Sum Turnkey basis with Single point responsibility.

Scope of work of the LSTK Contractor shall include supply, Basic Design and Detailed Engineering, Procurement, Supply, Fabrication, Inspection by Third Party Inspection Agency (TPI) as applicable, Insurance, Transportation of all equipment / materials to work site, Storage, construction and erection of all civil, mechanical, electrical and instrumentation works, assembly and Installation, obtaining all necessary statutory approvals, Testing, Mechanical Completion, Pre Commissioning, Commissioning, Performance Guarantee Test Run (PGTR) including Total Project Management and handing over of the plants and facilities under contractor scope of work duly completed on single point responsibility basis.

The following plants and facilities shall be under the scope of the LSTK Contractor:

1. System Parameters and Operation & Control Philosophy
2. Wagon Tippler
3. Side Arm Charger
4. Chutes & Hoppers
5. Apron Feeder
6. Belt Conveyor System
7. Paddle Feeder
8. Brakes & Clamps
9. Monorails and Hoists
10. Drive Equipment
11. Belt Scale
12. Dust Control & Miscellaneous System Ventilation System
13. Inline Magnetic Separator and Suspended Magnet
14. Metal Detector
15. Weigh Bridge
16. Interface with downward Material handling system

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2.0 PLANT LOCATION:

The proposed project will be located within the premises of existing closed coal based Ammonia-Urea complex of FCI Limited, Talcher Unit.

The total land area of the site is 933.60 acres out of which lease hold land from Government of Odisha is 923.27 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. FCIL had full-fledged fertilizer complex of Ammonia-Urea plants at this site which was in operation for over a period of 25 years and closed down since December 2002. It may be noted that, Soil investigation study have to be done by LSTK Contractor in the area selected for the project within existing premises of FCIL.

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 airport, Bhubaneswar is 150 km, 3 hours journey by road/ rail. Nearest port is Paradip, 200 km by rail/road. Talcher is situated at 21° 10" N Latitude and 82° 5" E Longitude.

3.0 PLANT/ SYSTEM CAPACITY & CONFIGURATION:

The overall project would essentially consist of new Ammonia and Urea plants and related off-site and utility facilities.

The broad provision of plants and facilities envisaged for the contractor has been presented in following Tables:

Sl. No.	Plants & Facilities	Capacity	Remarks
1.	Wagon tippler	Design- 25 Tips per hour	
2.	Hoppers in wagon unloading plant for wagon tippler	180 MT	
3.	Track hoppers in wagon unloading plant	Total – approx.4000MT	
4.	Apron feeder	Rated – 1250 TPH Design- 1500 TPH	
5.	Paddle feeder in track hopper building	Rated – 1000 TPH Design- 1200 TPH	
6.	Conveyor belt system	Rated - 1250 TPH. Design- 1500TPH. Max. Belt Speed – 3.0 m/s	

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4.0 DESIGN PARAMETERS:

4.1 Site Metrological Data

Talcher

1.	Atmospheric Pressure	
	Maximum	1008.0mbar
	Minimum	984.1 mbar
2.	Ambient Temperature	
	Dry bulb (Summer)	46.3 Degree Celsius
	Dry bulb (Winter)	1.0 Degree Celsius
	Average Temperature	31.9 Degree Celsius
	wet bulb	32.0 Degree Celsius
	Max for Mechanical / Civil / Structural	35.0 Degree Celsius
	Minimum for winterization (Average)	18.7 Degree Celsius
3.	Min. Design Air Temperature, unless otherwise mentioned in respective design specification	
	For Mechanical Equipments	35 Degree Celsius
	For Electrical Equipment, Max/Min	50 Degree Celsius
4.	Rainfall	
	Annual rainfall	1329.00 mm
	Design rainfall (per hour)	116 mm
5.	Wind Velocity	
	Basic design Wind Velocity (Structures)	50m/sec
6.	Relative Humidity	
	Maximum	100%
7.	Seismic zone	III(Three)
8.	Elevation above mean sea level	It should be established in consultation with owner/consultant based.
9.	Site co-ordinates	N-23122910.151, E-308680.833

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5.0 TIME SCHEDULE:

- 5.1 Contractor/Bidder shall furnish programme in form of master network identifying main phases in various areas of total work like design, engineering, procurement of materials and bought out items, manufacture of equipment, delivery and field activities.
- 5.2 Master network shall be prepared in Primavera software, discussed and agreed upon. Engineering drawings and data submission schedule shall also be discussed and finalized before issue of letter of intent. Liquidated damages livable for delays shall be effective from the dates mentioned above.
- 5.3 After award of contract, the contractor/bidder shall plan sequence of work of manufacture and erection to meet the plant commissioning dates given above and shall ensure that all work/manufacture, shop testing and shipment of equipment is in accordance with required construction/execution sequence.
- 5.4 Within fifteen days after award of letter of intent bidder shall submit for review and approval of detailed network schedules based on master network as mutually agreed upon, showing logic and duration of activities in following major areas: Detailed engineering, procurement, manufacture, shop, inspection, testing, dispatch/shipment, receipt at site, civil and structural work.

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SECTION VI- 2.0

SCOPE OF WORK

COAL/PETCOKE/LIMESTONE HANDLING FROM RAILWAY SIDING TO STORAGE YARD

**PROJECT: INTEGRATED COAL BASED FERTILISER
COMPLEX, AT TALCHER, ANGUL DISTRICT,
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1.0 CONTRACTOR'S GENERAL SCOPE OF WORK:

- i. Contractors/Bidder's Scope of work shall include but not limited to the followings:-
 - a) Basic Design and Detailed Engineering and interface with downward material handling system.
 - b) Manufacturing of the complete system
 - c) Procurement, Fabrication & Supply of the complete system
 - d) Inspection by Third Party Inspection Agency (TPI) as applicable of the complete system
 - e) Packing & forwarding of each item of the complete system
 - f) Transportation of each item of all equipment / materials to work site
 - g) Unloading & storage at site of each item for complete system
 - h) Painting of complete system
 - i) Insurance of complete system
 - j) Construction and Erection of all Mechanical, Electrical and Instrumentation items/works of complete system
 - k) Assembly and Installation of each item for complete system
 - l) Obtaining all necessary statutory approvals (if applicable)
 - m) Testing of complete system
 - n) Mechanical Completion, Pre-Commissioning, Commissioning of complete system
 - o) Performance Guarantee Test Run (PGTR)
 - p) Guarantee of Complete system
 - q) Project Management and handing over of the plants and facilities under contractor's/bidder's scope of work duly completed on single point responsibility basis.
- ii. The following plants and facilities, including civil works shall be under the scope of the Contractor/Bidder:-
 - a) Material unloading through wagon tippler to respective conveyor.
 - b) Material unloading from track hopper to respective conveyor.
 - c) Conveyor belt system and its associated equipments.
 - d) Dry Fog Dust suppression system at all appropriate location as mentioned.
 - e) Air Compressor & Piping required for service air, service water and drinking water at all appropriate location.

	COAL/PETCOKE/LIMESTONE HANDLING FROM RAILWAY SIDING TO STORAGE YARD TALCHER FERTILIZER PLANT, ODISHA SCOPE OF WORK	PC0183/4009/SecVI/2.0	0	
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- f) All Electrical items and systems required for wagon unloading & material handling package as mentioned in Electrical specification.
- g) All Instrumentation items and systems required for wagon unloading & material handling package as mentioned in Instrumentation specification.
- h) Required piping of all utility lines from battery limit to the required locations.
- iii. Following raw material & utility piping lines shall be made available to the contractor/bidder at one point only at their battery limit. Further distribution to the required location considering attached piping specification shall be under scope of contractor/bidder.
- a) Drinking Water
 - b) Service Water
 - c) Instrument Air
 - d) Cooling Water if required
 - e) Fire water
 - f) Power
 - g) Service/plant air
- iv. For detail scope of works refer following respective section –
- Material Handling – PC0183/4018/SecVI/3.1.1
 - Rotating equipment - PC0183/4018/ SecVI/3.1.2
 - Static equipment - PC0183/4018/ SecVI/3.1.3
 - Piping - PC0183/4018/ SecVI/3.1.4
 - Fire Fighting - PC0183/4018/ SecVI/3.1.5
 - Instrumentation - PC0183/4018/ SecVI/3.2
 - Electrical – PC0183/4018/ SecVI/3.3
 - Civil and structural work- PC0183/4018/ SecVI/3.4
 - Const-Erect-Painting -Pre-com-Com-Start-up- PC0183/4018/ SecVI/4.0

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SECTION VI- 3.0

DESIGN SPECIFICATION

COAL/PETCOKE/LIMESTONE HANDLING FROM RAILWAY SIDING TO STORAGE YARD

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1.0 DESIGN SPECIFICATION:

Contractor/Bidder to follow Design specifications applicable for the scope as attached herewith –

- i. DESIGN SPECIFICATION - MATERIAL HANDLING
- ii. DESIGN SPECIFICATION - ROTATING EQUIPMENT
- iii. DESIGN SPECIFICATION - STATIC EQUIPMENT
- iv. DESIGN SPECIFICATION - PIPING
- v. DESIGN SPECIFICATION – FIRE FIGHTING
- vi. DESIGN SPECIFICATION – INSTRUMENTATION
- vii. DESIGN SPECIFICATION – ELECTRICAL
- viii. DESIGN SPECIFICATION – CIVIL & STRUCTURAL

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SECTION VI- 3.1.1

DESIGN SPECIFICATION – MATERIAL HANDLING

COAL/PETCOKE/LIMESTONE HANDLING FROM RAILWAY SIDING TO STORAGE YARD

**PROJECT: INTEGRATED COAL BASED FERTILISER
COMPLEX, AT TALCHER, ANGUL DISTRICT,
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7.0	List of major equipments and Nomenclature
8.0	Description of the system
9.0	Design requirements
10.0	Details of Equipment
11.0	Inspection & testing

	COAL/PETCOKE/LIMESTONE HANDLING FROM RAILWAY SIDING TO STORAGE YARD TALCHER FERTILIZER PLANT, ODISHA DESIGN SPECIFICATION- MATERIAL HANDLING	PC0183/4018/Sec VI/3.1.1	0	
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LIST OF ATTACHMENTS

SL. NO.	DOCUMENT NO.	DESCRIPTION
1.0	PC0183-DD-0001- BC	Combined Data Sheet of Bulk Material Handling Conveyor
2.0	PC0183-DD-0001- WT	Data Sheet of Wagon tippler - Talcher
3.0	PC0183-DD-0001- SAC	Data Sheet of Side Arm Charger - Talcher
4.0	PC0183-DD-0001- AF	Data Sheet of Apron feeder- Talcher
5.0	PC0183-DD-0001- PF	Data Sheet of Paddle feeder - Talcher
6.0	PC0183-DD-0001- BS	Data Sheet of Belt Scale- Talcher
7.0	PC0183-DD-0001- ILMS and SM	Data Sheet of In line Magnetic Separator and Suspended Magnet - Talcher

SL. NO.	DRG. NO.	DESCRIPTION
1.0	PC0183-1400-0001	Material Flow Diagram
2.0	PC0183-1400-0002	Conveyor Layout
3.0	PC0183-1411-0001	GA Of Track Hopper and Belt Conveyor BC-01A & BC-01B
4.0	PC0183-1411-0002	GA Of Wagon Tippler and Belt Conveyor BC-02A & BC-02B
5.0	PC0183-1411-0003	GA Of Belt Conveyor BC-03A & BC-03B
6.0	PC0183-1411-0004	GA Of Belt Conveyor BC-04A & BC-04B
7.0	PC0183-1411-0005	GA Of Belt Conveyor BC-05A & BC-05B
8.0	PC0183-1411-0006	GA Of Belt Conveyor BC-06A & BC-06B
9.0	PC0183-1411-0007	General Notes

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1.0 INTENT

This specification together with all enclosures cover the requirements for detailed design, engineering, manufacturing, inspection, testing, painting, supply, packing & forwarding, transportation to site, unloading & storage at site, erection/installation, assembly, trial run on no load, commissioning, smooth & trouble free operation and guarantee test run and acceptance of complete system including guarantee of complete Wagon unloading system and material Handling system (Coal/Petcoke/Limestone) from railway siding to material storage yard, related equipment and Dry fog Dust suppression system along with supply of spares for commissioning and 2 years' operation for M/S TFL at Talcher (Odisha).

2.0 SCOPE OF WORK

The scope of work of Material handling system shall consist of, but not limited to the following:-

- a) Complete wagon unloading system by wagon tippler and track hopper.
- b) Belt conveyor system for material handling from wagon tippler complex and track hopper building to storage yard.
- c) Dry fog Dust suppression system at all appropriate location as mentioned.

Contractor/Bidder to follow below mentioned drawings:-

- i. PC0183-1400-0001- Material Flow Diagram- Material Handling system for Talcher.

Layout of Conveyor gantry, Transfer towers etc, levels of conveyors/ height of transfer towers, size, capacity and number of equipment mentioned in tender documents/shown in the conceptual drawings / layout are minimum requirements and tentative. The same shall be adjusted accordingly by the Contractor/bidder during detail engineering to suit their design as required to meet the bid requirement. All such changes pertaining to change in elevation, height, levels and any increase in capacity/ size/ number of equipment etc. shall implemented by the contractor without any cost and time implication to Owner/Consultant.

The data sheets and drawings indicate service requirements of proposed system and these shall be in no way relieve the bidder of his responsibility for providing equipment capable of meeting the required performance.

3.0 EXTENT OF SUPPLY

	COAL/PETCOKE/LIMESTONE HANDLING FROM RAILWAY SIDING TO STORAGE YARD TALCHER FERTILIZER PLANT, ODISHA DESIGN SPECIFICATION- MATERIAL HANDLING	PC0183/4018/Sec VI/3.1.1	0	
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The extent of supply for complete wagon unloading ,material handling system and including related equipment shall consist of, but not limited to the following :-

1. Track hopper, paddle feeder Conveyors its associated conveyors and equipments. (Track Hopper-1, PF-1, PF-2, PF-3, PF-4, BC-1A/1B) including all relevant components/parts.
2. Wagon tippler, side arm charger, apron feeder and its complex, its associated conveyors and equipments. (WT-1; SAC-1; AF-1, BC-2A/2B) including all relevant components/parts.
3. Conveyors system from wagon tippler complex, track hopper building, underground transfer point (TP-1, TP-2, TP-3), conveyor tunnel, penthouse (PH-1) to associated over ground transfer tower (TP-4,TP-5) of storage yard through Conveyor-BC-3A/3B, BC-4A/4B, BC-5A/2B, BC-6A/6B) including all relevant components/parts.
4. Dust Control & Ventilation System
5. Dewatering system with pump house
6. Continuous belt weighers
7. Electric Hoists
8. Fire fighting system
9. All hoppers.
10. All Chutes with motorised wherever applicable
11. All diverters/Prism Gate (Electric operated)
12. All Electrical Motors, MCC and various other related items & system as per Electrical specifications.
13. All field & control room instrumentation including PLC, Control Desk, Monitors etc as per Instrumentation specifications.
14. Interface with coal/petcoke/limestone storage and feeding system to Gasifier.
15. Road Weigh Bridge required for the plant including control system/facilities.
16. All civil and structural work.

Any other items/equipments not mentioned here, but required for the system, have to be mentioned & supplied by bidder. Completeness of the system is the responsibility of the bidder.

4.0 EXTENT OF ERECTION & COMMISSIONING

	COAL/PETCOKE/LIMESTONE HANDLING FROM RAILWAY SIDING TO STORAGE YARD TALCHER FERTILIZER PLANT, ODISHA DESIGN SPECIFICATION- MATERIAL HANDLING	PC0183/4018/Sec VI/3.1.1	0	
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Extent of Supply including erection & commissioning of Equipment shall consist of the following:-

1. Complete Conveyors system including all other relevant components/parts.
2. Wagon tippler, side arm charger.
3. Apron feeder with dribble conveyor
4. Track hopper, paddle feeder.
5. Continuous belt weighers
6. Electric Hoist
7. Dry Fog type Dust Suppression system at required place
8. All Chutes
9. All diverters (Electric operated)
10. All Electrical Motors, MCC and various other related items & system as per Electrical specifications.
11. All field & control room instrumentation including PLC, Control Desk, Monitors etc as per Instrumentation specifications.
12. All technological structure of equipments.
13. Road Weigh Bridge required for the plant including control system/facilities.
14. All civil and structural work.

However, supply, installation & commissioning of the equipment shall not be limited to the above only and the bidder have to provide all the equipment / items required to make the system complete for safe, satisfactory and smooth commissioning of the system & trouble-free operation including ease of maintenance.

5.0 **INCLUSIONS**

- a) Wagon tippler (WTP) complex and track hopper (TH) building..
- b) All Conveyor gantry & transfer tower (TT) buildings.
- c) Under ground and over ground civil work.
- d) All structural work.
- e) Supply and Laying of Rail and Rail Fixing arrangement for EOT cranes, Hoist mono rail.
- f) Road Weigh Bridge required for the plant including control system/facilities.

However, proper layout drawings of conveyors gantry, Transfer tower, & platform etc and specification with size of rail for each equipment with fixing detail & load data to be provided by bidder during detail engineering stage.

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6.0 DESIGN CODES & STANDARD

Conveyor System	“Conveyor Equipment Manufacturer’s Association” (CEMA) or IS : 11592 latest edition
Conveyor Belting	IS : 1891 latest edition or equivalent / ISO
Flat Belt/Slat Conveyors	IS : 8597 latest edition or equivalent / ISO
Conveyor Pulleys	IS : 8531 latest edition or equivalent / ISO
Conveyor Idlers	IS : 8598 latest edition or equivalent / ISO
Conveyor safety	IS : 7155 latest edition or equivalent / ISO
Troughed Belt Conveyors	IS : 4776 latest edition or equivalent / ISO
Use & Selection of Bucket Elevator	IS : 7167 latest edition or equivalent / ISO
Code of practices for selection of belt feeder	IS : 12215 latest edition or equivalent / ISO
Belt conveyors - Travelling tripper - Motorised-for belt widths 650 mm to 1600 mm - Dimensions	IS : 14386 latest edition or equivalent / ISO
Dust Extraction system	ACGIH latest edition or equivalent /ISO

7.0 LIST OF MAJOR NOMENCLATURE

NOMENCLATURE	DESCRIPTION
TP/JH	Transfer Point /Junction house
BC	Belt conveyor
H	Hopper
TH	Track hopper
WT	Wagon tippler
SAC	Side arm charger
PF	Paddle feeder.

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8.0 DESCRIPTION OF THE SYSTEM

Brief description of proposed Raw Material (Coal, pet coke and lime stone) handling Plant.

This shall be read in conjunction with layout enclosed elsewhere in the NIT.

- (i) The Raw Material received from Box-N wagons shall also be unloaded wagon tippers. Wagon tippler hopper shall have a loading capacity of minimum 3 wagons loads of Raw Material i.e. 180 T (Single hopper). One Side Discharge wagon tippers (WT-1) are to be employed for unloading Raw Material rake. Side arm charger is envisaged for placement of wagon on the tippler table & removal of empty wagon from tippler table after tipping. Clear access shall be provided for movement of pay loaders/ bulldozers on the hopper grating of wagon tippers. Gratings over wagon tippler hopper shall be placed and designed accordingly. Apron feeders AF-1 along with dribble conveyor are employed under wagon tippler (WT-1) for extracting Raw Material from wagon tippler hopper and feed onto underground reclaim conveyor BC-2A/2B will feed to BC-3A/3B which will finally feed material to TT-2 (not in bidder's scope) via Common conveyors (BC-4A/4B,5A/5B/6A/6B) through transfer towers /transfer points.
- (ii) In case of track hopper, bottom discharge and side discharge wagons will be unloaded, Total 4 number paddle feeders (PF-1,PF-2,PF-3,PF-4), each of 1000 TPH rated capacity /1200 TPH design capacity shall be installed at the bottom of the Track hopper to scoop the Raw Material (Coal, pet coke and lime stone) from track hopper and feed Raw Material on to the underground conveyors BC-1A/1B which will feed material to common conveyors BC-3A/3B respectively which will finally feed material to TT-2 (not in bidder's scope) via Common conveyors(BC-4A/4B,5A/5B/6A/6B) through transfer towers/transfer points. Bidder to consider the pneumatic door opening mechanism for bottom and side discharge wagons at track hopper.
- (iii) Bidder to consider VFD drive for Apron Feeder and for rotary blade of Paddle feeders to control flow rate of three different material {Coal (-100mm), Petcoke (-30mm), Limestone (-200mm)} received at Wagon tippler & Track Hopper and to maintain constant flow rate at downstream conveyors (Rated/Design-1250tph/1500tph).
- (iv) 1 no Wagon tippler WT-1 along with one Side arm charger SAC-1 and one apron feeders AF-1 shall be provided to unload Raw Material from Box-N wagons. One numbers dribble conveyors shall be provided one below each apron feeder. Apron feeder AF-1 receiving Raw Material from WT-1, Apron feeder shall be of 1250/1500 TPH (rated / design) capacity.
- (v) Suspended magnets SM-1, SM-2 shall be provided on Conveyor BC-1A/1B and BC-2A/2B at underground transfer point TP-1 and TP-2 for removal of tramp Iron pieces. Two (2) numbers metal detectors MD-1, MD-2 and Two (2) numbers Belt Scale (BS-1, BS-2) shall be provided on Conveyors BC-3A/3B to detect metals measurement of Raw Material flow rate respectively.
- (vi) At Pent House (PH-1) conveyor belt BC-4A/4B shall have facility for manual stone picking, at a suitable location.

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- (vii) All respective building should have hoisting facility like EOT crane, electrical hoist or mechanical chain pulley block with required hatch opening for maintenance purpose considering the highest weight and dimension of the equipments parts.
- (viii) In this system, BOXN and BOB type wagon may unload simultaneously. In that case one stream run for Wagon tippler and other stream run for track hopper.
- (ix) Instruments / Electrical interlock system (logic control for tripping & restart of the system) to be considered & provided by bidder. Minimum Flow path/ assumed continuous running equipment to arrive guaranteed power consumption with handling of coal shall be considered as follows:-

Wagon Tippler WT-1 with side arm charger SAC-1, Apron Feeder AF-1 with dribble conveyor, Paddle Feeder (PF-1 & PF-2) or (PF-3 & PF-4), Conveyor BC-1A/BC-1B, BC-2A/BC-2B, BC-3A, BC-3B, BC-4A, BC-4B, BC-5A, BC-5B, BC-6A, BC-6B, Inline Magnetic Separator ILMS-1, ILMS-2, all Dry Fog Dust suppression System and all Ventilation system.

9.0 **DESIGN REQUIREMENTS**

9.1 The equipment and the system shall be generally designed to suit the following:

9.1.1 Layout for material Handling System drg. – PC0183-1400-0002.

9.1.2 Proposed Scheme for handling of Coal/ Petocke/ Limestone drg. – PC0183-1400-0001.

9.2 Related specifications, standards and codes referred to in this Technical Specification / drawings shall be of the latest issue including all addenda and supplements there to.

9.3 Enclosed drawings/data sheets indicate only the concept of the complete system as envisaged by Owner/consultant. It will be the sole responsibility of the Contractor/Bidder to supply the suitable equipment and ensure that the system is complete and adequate for the specified requirement.

If anything extra is required to complete system, the same shall have to be provided by the contractor/bidder.

The Contractor/Bidder is advised to spell-out clearly in their offer regarding any such additional equipment required. No extra claim shall be entertained after placement of LOI / P.O.

9.4 The contractor/bidder shall provide adequate facilities for carrying out maintenance of the system/individual equipment, its accessories etc. This would include provision of adequate handling equipment, working space, platforms, access ladders, stair cases and safety devices.

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9.5 All equipments should be capable to start / run on full load condition. Complete system should be smooth & trouble-free operational.

9.6 MOC of all equipments/parts in contact with raw material should be as per standard.

10.0 DETAILS OF EQUIPMENT

10.1 CONVEYORS SYSTEM INCLUDING RELATED ITEMS

10.1.1 Conveyors System

- i) All Conveyors shall include structural supports, all drives, pulleys, idlers, belting, skirt boards, emergency switches, protective devices, take-up etc.

The belt conveyors shall be complete with but not limited to the following:

Belting

Drives along with base frame

Pulleys

Bearings

Belt take-up

Idlers

All chutes

Belt cleaner, both external as well as internal

Conveyor props (Short Support)

Conveyor Stringers

Decking plate

Safety guards

Belt sway switches, Pull Cord Switches, zero speed switches, gravity take-up switches etc. All required electrical & Instrumentation.

- ii) All conveyors outside buildings shall be in enclosed galleries having main walk-way of min. 1100 mm clear width on one side and min. 800 mm clear width on other side of conveyors.
- iii) All conveyors' Gantry which crosses plant access roads should have a minimum head-room of 10 metres wherever possible; in other case head-room shall not be less than 8 metres. Adequate stairs, walk-ways, platforms and hand rails, toe-guards shall be provided on all handling equipment for ease in access and maintenance.

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- iv) The belt speed shall be optimum so as to minimise material degradation, spillage and generation of dust. Conveyor Belt speed shall not generally exceed 3.0 m / sec.
- v) All conveyors shall be equipped with MS deck plate (4 m length at receiving end and 2m length at discharge end) for all conveyors, to be installed under the belt and should not be in contact with the carrying belt at any diverting point.
- vi) The conveyors receiving raw material from another conveyor shall be horizontal at those transfer point as far as possible.
- vii) Conveyor inclination shall be generally limited to 14⁰ with horizontal. In special conditions, if required, it may be limited to 16⁰ with horizontal.
- viii) Bulk material shall be handled in troughed belt (35⁰ troughed) and raw material in the flat belt conveyors.
- ix) All inclined conveyor shall be equipped with hold back to prevent reverse run of the belt under load.
- x) The skirt boards and sealing with overlapping block design shall be provided with labyrinth seals.
- xi) All the conveyors shall be provided with identical designed frame size, roller size, pulley size etc. as far as possible to have better interchangeability and reducing the inventory.
- xii) All conveyors' belts shall be fitted with multi-blade sprung type external belt scraper with modular segment polyurethane blade (primary and secondary scraper) below head pulley and V-type internal belt scraper. All cleaning including coal, limestone, petcoke from the belt shall fall within the head chute.
- xiii) All supporting technological structure / frames for supporting equipments (battery limit: from the floor or ceiling of buildings and galleries or from ground).
All nuts, bolts, fasteners, gaskets, required flanges, washers etc. shall be of guarantee good and safe operation at the guaranteed capacity.
- xiv) All Conveyors shall be provided with hooters before start of the conveyor.
- xv) The bulk conveyor system should run with ZERO spillage.
- xvi) For bulk handling conveyors (trough belt), top of belt shall be considered as min. 1200mm from floor level. Accordingly, Conveyors short support shall be considered. This is the minimum requirement and bidder to design as per calculation & standard.

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- xvii) The conveyors shall be suitable for 24 hours continuous running/duty.
- xviii) Conveyor supporting structure should be closed gallery with walkway on both sides.
- xix) All belt conveyors shall have suitable gravity take-up unit or screw take-up or horizontal gravity take-up as per good engineering practice.
- xx) Continuous belt weigher shall be installed on conveyor at suitable locations. Display of this weigher would be connected through control panel.
- xxi) Magnetic separator arrangement of adequate capacity to be provided at suitable location to separate any unwanted particle from raw material (coal/petcoke/Limestone).
- xxii) The belting shall be of synthetic fabric such as Nylon-Nylon with rubber covers (top thickness-5mm and bottom thickness-3mm, Splicing–Hot Vulcanized) as per IS1891 of adequate flexibility to give a troughing angle of 35 deg.
- xxiii) Conveyor drive shall be directly coupled through suitable helical gear box.
- xxiv) High speed coupling shall be Gear /Resilient coupling for drive of rating less than 30KW and fluid coupling for drive rating 30kw or more. Low speed coupling shall be gear /resilient type.
- xxv) Minimum service factor for coupling shall be taken as 2.0 on the absorbed power.
- xxvi) Minimum service factor on gear boxes shall be taken as 1.5 over the absorbed power.
- xxvii) All equipment's / assemblies shall use bearing fitted in Plummer block.
- xxviii) Self-aligning training idler spacing to be considered as maximum 15m for carrying side & maximum 30m for return side.
- xxix) Impact idlers (minimum dia.139.7mm x 4.5mm thick lagged with dia.190mm rubber disc, minimum 5 nos.) shall be provided at loading points at spacing of 300 mm. Impact idlers shall be of rubber lagged type.
- xxx) Carrying idlers, transition idler, self alignment carrying idler, return idler and self alignment return idler shall be minimum dia.152.4mm x 4.5mm thick.
- xxxi) Self cleaning return idler shall be minimum dia.139.7mm x 4.5mm thick lagged with minimum dia.190mm rubber disc.
- xxxii) Head/ Drive Pulley shall be 800mm outer diameter x 1600mm face width x 20 mm thick shell and shall be lagged with 12mm thick Diamond Groove. Tail Pulley, Take-up pulley, Snub Pulley and Bend Pulley shall be 630mm outer diameter x 1600mm face width x 16 mm thick shell and shall be lagged with 12mm thick Plain Rubber.

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- xxxiii) All diverter & gate shall be electrically operated.
- xxxiv) For safety of conveyors and personnel, all conveyors shall be provided with safety switches like zero speed switch, belt sway switch and pull cord. In addition to these there shall be provision of audible warning (Hooter) of starting of conveyor.
- xxxv) Suitable hold back devices for preventing running back of the conveyor belt in case of conveyor being stopped in loaded conditions due to power failure or during normal operational delays shall be provided to give positive protection. The hold back shall instantaneously engage without shock and be capable of protecting equipment and personnel. It shall be released instantly when 'power' resumes or the 'delay' is removed. The holdback devices shall be integral with gearbox.
- xxxvi) Communication facilities shall be provided at regular intervals throughout the conveyor system.
- xxxvii) Chute shall be made of Tiscral / Sailhard with thickness minimum 20 mm and non striking face with 10mm thick M.S Plate.
- xxxviii) In double stream conveyors central walk way width shall be minimum 1100mm and side walkway width shall be minimum 800mm.
- xxxix) All Conveyor galleries shall be provided with dust sweeping chutes covered with removal chequered plates. There shall be one dust hopper for each walkway of gallery and the same shall be provided at the middle of walkway near trestle location.
- xl) All over ground conveyors are provided with covered galleries. Crossover shall be provided at 100 m intervals (no cross over for conveyors less than 100 m). Gallery shall be designed to accommodate cable & pipes including fire water, Dust Suppression pipelines.
- xli) Walkway shall be of chequered plate construction with anti skid arrangement. Both sides of the central and side walkway shall be provided with pipe hand rail with kerb plate using pipe of 'medium' class as per IS: 1239 having 32mm nominal size. Handrail shall not be connected to conveyor supporting stringer.
- xlii) The inclination of conveyors inside the tunnel shall be limited to 12 degree. The inclination of conveyors above the ground level shall be as per CEMA / IS11592. Conveyor system shall be designed with zero leakage of Coal/Petcoke/Limestone.
- xliv) Repose angle of coal shall be considered as 37°.
- xlv) All the equipment shall be suitable for handling damp and sticky coal during monsoon season with moisture content of 20% and fines upto 40%.
- xlv) The type of high speed coupling between motor and gear box shall be as follows:
- (a) For motor rating up to 30 kW - Resilient type

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- (b) For LT motors between 30 kW and 175 kW - Traction type fluid coupling
(c) For HT motors - Actuator operated scoop type fluid coupling
If scoop type fluid coupling is applicable, fan cooling arrangement shall be provided and water cooling shall not be provided.

xlvi) For over ground conveyors take-up shall not be provided in the pits. Sand pit shall be provided at the ground level.

10.1.2 Capacity

The handling capacities of all proposed conveyors have been mentioned in the conveyor Specification/data sheets. Conveyor capacity (Rated 1250TPH & Design 1500 TPH) shall be such that it shall be adequate to handle the material coming from wagon tippler complex to material storage yard.

10.1.3 Belting

All belting shall be of Nylon x Nylon of adequate strength, free of longitudinal & transverse buckling, wavy cord or any other unevenness that cause localized points of flexing when belt is in service. Factor of Safety shall be taken as 10. Width tolerances shall not exceed 1%. All plies shall be mildew inhibited. Belting with repaired carcass, brow-ups shall not be acceptable. All belting constructions will be standardized as far as practically possible. The belt construction will be of nylon / nylon carcass with rubber covers anti-abrasive type. Unless other-wise specified, belt splices shall be field hot vulcanized and the belt shall include sufficient length for the splice. The belting shall be tested as per IS: 1891.

10.1.4 Drives

- The Conveyor drive shall be directly coupled through helical gear box. Uniform type gear box units should be provided for all similar conveyors.
- All the drives shall preferably be consisting of electric motor, gear box, coupling, shaft and terminal board.
- Cast steel or Welded steel housing shall be considered for gear box.
- Input coupling shall be considered as Pin & Bush type for Conveyor Motor rating up to 30Kw & for more than 30Kw motor, fluid coupling shall be used for all conveyors. For output coupling gear/resilient coupling shall be considered.

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- e) Service factors for all mechanical power transmission equipment/ gear box shall be 1.5 to 1.6 of the absorbed power.
- f) Minimum service factor for flexible coupling shall be taken as 2.0 on the absorbed power.

10.1.5 Pulleys and Shafts

- a) All pulleys and shafts are to be designed for worst conveyor loading conditions and should be standardized as far as practically possible.
- b) Pulleys shall be of welded steel construction, statically balanced, stress relieved after welding before machining, continuous rim, two end disc type. Pulleys shall be balanced and concentric about the shafts.
- c) All head/drive pulleys shall be lagged in herring-bone/diamond pattern. Head/Drive pulleys shall be lagged with min. 12 mm thk. Neoprene. The hardness of the lagging shall be 65 to 70 shores "A" scale
- d) All Tail & rest of pulleys shall have min. 12 mm thick smooth plain neoprene lagging with a hardness of 60 to 65 shores "A" scale.
- e) Shaft deflection shall be limited to 0.066% of bearing centres. All shafts shall be provided with accurately machined key seats.
- f) Shaft ends shall be flush with bearings edge, unless the extension is required for mounting components.
- g) Head/ Drive Pulley shall be 800mm outer diameter x 1600mm face width x 20 mm thick shell and shall be lagged with 12mm thick Diamond Groove. Tail Pulley, Take-up pulley, Snub Pulley and Bend Pulley shall be 630mm outer diameter x 1600mm face width x 16 mm thick shell and shall be lagged with 12mm thick Plain Rubber.

10.1.6 Idlers

- a) All idlers- carrying, return, impact idlers/rollers shall be of ERW tubes construction unless otherwise specified. Idlers shall be permanently lubricated & sealed for life. Seize resistant type anti-friction bearings and dust proof seals shall be used on all idlers, selected for life of 40,000 hours minimum.

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- b) Carrying idlers of material handling conveyors shall be of non-lagged type. Impact idlers of all conveyors shall be of rubber lagged type (min. 25 mm thk.).
- c) Transition non-lagged type idlers shall be provided for material transfer between in line conveyors.
- d) Self-aligning (training) idler spacing to be considered as – max. 15m for carrying side & max. 30m for return side.
- e) Idler face width shall be considered as per standard.
- f) Troughing idler shall be with grease packed sealed deep groove anti-seize type ball bearings. Idler bearings shall be provided with multi-labyrinth seals. Troughing angle of 35⁰ shall be used for bulk material handling.
- g) Impact idlers (minimum 5 nos.) shall be provided at loading points at spacing of max. 300 mm.

10.1.7 Bearings and Pillow Blocks

- a) For Idlers, all bearings shall be of deep groove ball bearing type and For pulley, all bearings shall be of heavy duty spherical roller bearings with minimum life rating of 40,000 hours under the total loads imposed.
- b) All bearing, to be used in equipments/assemblies shall be fitted in Plummer block. Cast steel construction shall be considered for plummer block.
- c) All pillow blocks shall be fully self-aligning with one fixed end and one expansion type for each shaft assembly. They shall include enclosures caps where non drive shafts terminate at bearings.
Grease seals shall be triple labyrinth type to effectively exclude micron size dust, dirt.

10.1.8 Belt Tensioning device (Take-Ups)

All belt take-up (Gravity, Screw, loop type) shall be properly designed with functional & maintenance approach. Screw take ups shall be heavy-duty protected screw type. The amount of travel for take ups shall be based on belt manufacturer's recommendations but shall not be less than 2% of pulley centres.

Counter weight material for gravity take-up shall be considered as concrete blocks.

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10.1.9 Bulk Transfer Chutes

- a) Chutes transferring raw material from one conveyor to another shall be designed in such a way that material fall height is minimum and the change in direction is achieved as smoothly as possible.
- b) All transfer chutes shall be provided with min. 20 mm thick Sailhard/Tiscral without mother plate and non –striking faces with 10mm thick M.S plate.
- c) Chutes shall be closed type. Inspection holes/window with covers shall be provided at all convenient locations.
- d) Speed of the material falling on conveyor belt in the direction of belt travel should be almost the same as that of the conveyor.
- e) The valley angle of chutes shall be 55° as far as possible but in no case less than 50° .
- f) Discharging chutes of conveyors shall be designed in order to allow a proper and smooth flow of material from one belt conveyor to the other belt conveyor / other item. Excessive direct fall of material to be avoided.
- g) Flap gate in chute shall be provided at desired location as mentioned. Flap gate shall be of made of 20 mm thick sailhard/Tiscral.

10.1.10 Hoppers

- a) The hoppers shall be of rectangular shape and constructed from R.C.C. (Grade-M35.) And complete inside surface of RCC hopper shall be 50 mm thick guniting.
- b) The capacity of hopper shall be Max 180T.
- c) The slope of hoppers shall be kept as 55° with the horizontal.

10.1.11 Dry fog Dust suppression system

Bidder to consider following Dry fog Dust suppression system:-

- a) Dry fog Dust suppression system shall be provided for suppressing dust from wagon tippler complex/plant (All discharge/receiving points of conveyor system, hoppers & other dust generating sources) including track hopper building.

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10.1.12 Access to Machinery

- a) Special attention shall be given in providing adequate access to all machinery for safe operation / maintenance and cleaning purpose.
- b) Gravity take-up shall be provided with the platform and access ladder for maintenance.
- c) Provision shall be made for lifting out and replacing equipments such as motors, gearboxes, conveyor pulleys, idlers parts and other heavy machinery in the wagon tippler complex and track hopper building with the help of electric hoist/ travelling chain pulley block. Capacity of the hoist/chain pulley block would be based on the weight of the heaviest part to be lifted.
- d) EOT crane shall be provided for maintenance of wagon tippler.

10.1.13 Safety Guards

Safety guards shall be provided for operating equipment. Guards shall completely enclose moving parts so that physical contact with the moving parts can not be made with the guard in place. Guards shall be constructed of steel wire net casing. Design and construction of guards shall permit easy removal and shall be of the hinged type.

10.1.14 Extent of Shop Assembly

The structural elements shall be despatched loose to be bolted in field. Head, tail and take-up frames shall be fully shop assembled, in order to check the correct manufacture and shall be shipped in partially assembled elements in order to reduce the shipping volume. Pulley shall be despatched complete with bearings and pillow blocks.

10.1.15 Other Design Factor

- a) Belt conveyors shall be able to operate continuously for 24 hours/day throughout the year at the service requirements.
- b) Belt conveyors with associated steel works design shall conform to the relevant Codes and Standards. Conveyor drives shall be designed for adequate start/stop operations and start with full load.
- c) The following noise limit shall be considered - 85 dBA max. (At 1 meter distance from the emitting noise source)

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- d) Conveyors shall be designed in order to avoid accidents to operators and maintenance personnel.
- e) The following status (minimum) shall be signalled to the Coal Handling plant control room: -
- start/stop of the motors
 - pull cord switches actuated
 - zero speed switches actuated
- f) The operation of wagon tipping/wagon unloading building shall be automatic with minimum manual intervention. Broad requirements of system are tabulated hereunder :-

Sl. No.	Parameter	Value
1.	Wagon tippler capacity :	25 Tip per hour
2.	Wagon unloading Operation by wagon tippler complex:	Wagon positioning will be done by side arm charger and tipping will be done by wagon tippler automatic.(Wagon type- BOXN Type)
3.	Wagon unloading Operation at track hopper building:	Unloading is done automatically from the bottom through Pneumatic Door Operating Mechanism activated by rail Side Devices mounted on the track. Wagon type:-BOBRN,BOBR(Bottom discharge)and BOBSN(Side discharge)
4.	Conveyor belt capacity:-	Approx. 1250 TPH (Rated) & 1500 TPH (Design)

10.2 CHAIN PULLEY BLOCK

- a) Travelling Chain Pulley Blocks complete with plain trolleys, adequate length of hand chain & load chain etc.
- b) Capacity and number of Chain Pulley Blocks with travelling trolley shall be worked out by contractor for M2 duty in conformity with IS: 3832 and submitted with bid.
- c) Required manual effort for Chain Pulley Block shall be as per the stipulations of IS:3832

10.3 ELECTRIC HOIST

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- a) Electrical hoists shall be considered where the requirement is to handle the critical equipment/component during maintenance, in case of long hoisting/traveling time and heavy loads.
- b) For electric hoists festoon type cable trolleys shall be considered. Also the hoist shall be operated from a push button type pendent from the floor. Separate main shall be considered for electrical supply for each hoist.
- c) Capacity and number of Electric Hoist shall be worked out by contractor for M2 duty in conformity with IS: 3938 and submitted with bid.

10.4 ROAD WEIGH BRIDGE

- a) Two (2) Nos. Electronic type road Weigh Bridge (Pitless type) of 100 MT capacity each of platform size minimum 18m x 4m (approx) each with boom barrier along with weigh bridge cabin facility shall be provided for weight recording and handling of Coal /Petcoke/Limestone and Ash/slag via road.
- b) Weigh bridge shall complete with all parts/mechanism including weighbridge platform, load cells, indicator, barriers, safety devices, Lighting & Surge Protection devices etc.
- c) Load cells and digitizers of electronic weighbridge shall be very robust in construction and suitable for urea, coal dusty environment. Load cell shall be with high protection class & with lightning protection. Load cells should have self diagnostics capabilities to identify problems and predict failures before it occurs.
- d) Broad specification of load cell is as under -
Hermetically sealed and Lightening protected
Protection :- min. IP 68
Safe load :- 150% of nominal capacity
Ultimate load :- 300% of nominal capacity
Load cell Accuracy :- +/- 0.01% of Nominal capacity (minimum)
Combined error:- ±0.03%
Covering :- Stainless Steel
- e) Weigh bridge cabin shall be provided with necessary Desktop computer with compatible control software as required, printer, paper, consumables for six (6) months of operation and associated instrumentation & Control system.

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- f) Weigh Bridge Control system shall be interfaced/hardwired with RMHS Control System for all electrical and instrumentation interface.
- g) Location/Co-ordinates of Weigh Bridge Control room shall be followed as per overall plot plan.

10.5 OTHER RELATED SYSTEMS

Contractor/Bidder to consider & provide following other systems related to raw material handling.

i) Piping of all required services

Following utility piping lines shall be made available to the contractor/bidder at one point of battery limit of Coal Handling plant, further distribution to the required location considering attached piping specification shall be under scope of contractor/bidder.

- a) Drinking Water
- b) Service Water
- c) Cooling water if required
- d) Instrument Air
- e) Service air as mentioned above (complete piping scope from compressor to required location)

Refer to DESIGN SPECIFICATION – PIPING

Bidder to provide/mention in the bid following utility requirements for applicable individual equipments/system –

- a) Instrument air
- b) Cooling Water if required

ii) Electrical system required for the complete wagon unloading and material handling package

Refer to DESIGN SPECIFICATION – ELECTRICAL

iii) Instrumentation system required for the complete wagon unloading and material handling package

Refer to DESIGN SPECIFICATION – INSTRUMENTATION

11.0 INSPECTION & TESTING

11.1 All components of the system shall be subjected to inspection and testing at different stages of manufacture as applicable as per approved QAP.

11.2 Contractor/Bidder to submit Quality Assurance Plan (QAP) for approval of Owner / Consultant to identify stages of inspection, acceptance criteria and extent of inspection.

	COAL/PETCOKE/LIMESTONE HANDLING FROM RAILWAY SIDING TO STORAGE YARD TALCHER FERTILIZER PLANT, ODISHA DESIGN SPECIFICATION- MATERIAL HANDLING	PC0183/4018/Sec VI/3.1.1	0	
		DOCUMENT NO	REV	
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- 11.3 Contractor/Bidder, on demand from Owner/Consultant shall carryout such tests in an appropriate manner in the presence of Owner / Consultant free of charge to owner.
- 11.4 If the equipment / part of equipment are to be manufactured at any other premises, the Contractor/bidder shall obtain permission for owner / Consultant to inspect and test.
- 11.5 In all cases where tests are to be carried out, the contractor/bidder shall provide free of charge such as labour, materials, apparatus and instruments and supervisory staff, as may reasonably be demanded, to carryout efficiently such tests of equipment, material or workmanship in accordance with the contract.
The equipment / part of equipment shall be immediately rectified / replaced if not found satisfactory by Owner/Consultant and refurnish it for re-inspection at the earliest possible date.
- 11.6 After assembly of each unit, it shall be subjected to tests as per the manufacturer's standard test procedure. This shall include a functional test of the smooth running of the equipment. The functional test may be witnessed by Owner/consultant at Vendor's shop. Contractor shall furnish necessary notice for witnessing shop tests to Owner/consultant in due course. If dismantling is required for improvement of performance in the tests, the initial test shall not be acceptable and the final test must be done after corrections are made.
- 11.7 The contractor/bidder shall dispatch the equipment only after getting dispatch clearance from Consultant / Owner / Third Party.
- 11.8 The contractor/bidder shall give at least 15 days clear notice to Owner/Consultant when the different parts / complete equipment are ready for inspection. If the equipment / parts are not provided for inspection on the appointed dates, the Owner / Consultant reserves the right to recover all the expenses incurred on their inspector's visit from the bidder.
- 11.9 No inspection test or acceptance during the course of manufacture or at final stages shall relieve the contractor/bidder from his responsibility for any failure to conform to the contract Specifications or for faulty design, material or workmanship which may subsequently develop up to the guaranteed period.
- 11.10 The contractor/bidder shall furnish necessary test certificates, drawings, radiographic examination reports and other relevant data as may be required for Owner/Consultant review. Such inspection by Owner / Consultant / Third Party shall however not relieve the bidder of their responsibility for the quality and workmanship guarantee of the equipment.

	COAL/PETCOKE/LIMESTONE HANDLING FROM RAILWAY SIDING TO STORAGE YARD TALCHER FERTILIZER PLANT, ODISHA DESIGN SPECIFICATION- MATERIAL HANDLING	PC0183/4018/Sec VI/3.1.1	0	
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11.11 Inspection at contractor/bidder's / sub-vendor's works by Consultant / Owner / Third Party shall not prejudice owner's claim for rejection of equipment / part or further inspection at site.

If the equipment are not of contract specification or fail to perform specified duties or otherwise not found satisfactory by Owner/Consultant, owner shall be entitled to reject the equipment / material or part thereof and ask for free replacement within reasonable time, failing which the owner has all the powers to obtain his requirements elsewhere at contractor/bidder's cost and risk.

In the event of such rejection the owner shall be entitled to the use of equipment in a reasonable and proper manner for a time reasonably sufficient to enable him to obtain replacement.

Equipment rejected by Owner shall be removed by contractor/bidder at his own cost within 14 days of notice.

Nothing in these clauses shall be deemed to deprive the owner of his right or in any way relieve the contractor/bidder of his obligation under the contract.



DATA SHEET: BELT CONVEYOR
EQUIPMENT: CONVEYOR (BULK HANDLING),

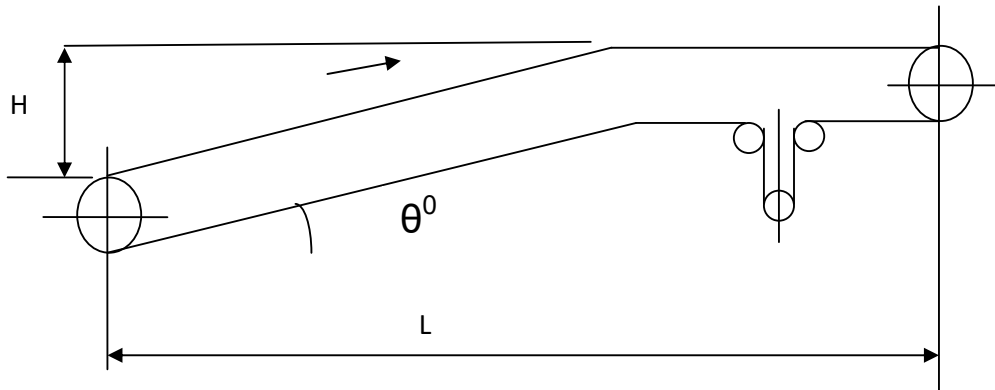
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LINE SKETCH (Refer attached layout Drawing)

APPLICATION DATA

Applicable to: - handling of Coal / Petcoke / Limestone. Purchase Proposal

Date:

Conveyors: - BC-1A/1B

Manufacturer :-

Quantity Required :- One No. each

Type :- Troughed, 3 equal rolls

Duty :- Continuous, 24 hrs/day

Troughing Angle :- 35°

Relative Humidity: - 100 % max.

Surrounding :- Dusty

Temperature :- Ambient

MATERIAL HANDLED DATA

Material: - Coal / Petcoke / Limestone.

Angle of Repose :- 30°~45°

Average Size, mm :- 100 / 30 / 200

Moisture: - 14.3 % max.

Max. Size, mm :- 200

Temperature :- Ambient

Percentage of Large Pieces :- 3% Max., Occasional

Abrasiveness :- Mild

Bulk Density (T / m³) :- 0.8 (Coal), 0.86 (Pet coke), 1.3 (Limestone)

TECHNICAL SPECIFICATION

Capacity, Te / hr :

Electric Motor :

Normal/ Rated :- 1250TPH

Make & Type :- 3 phase squirrel induction motor

Peak :-

Rating, K.W :-

Design :- 1500TPH

Speed, R.P.M :-

Belt Speed, :- 3.0 m/sec (Maximum)

Reduction Gear Box :

Belt Specification :

Type :- Helical Gear Box

Belt width, mm :- 1400

Make :-

Rating :-

Frame size :-

Construction :- Nylon/Nylon

Reduction ratio :-

Make :-

Efficiency, Min :- 85%

Duty :- HD

Lubrication :-

Cover grades :- FR

Weight, Kg :-

Cover Thickness, mm :- Top : 5 Bottom : 3

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DATA SHEET: BELT CONVEYOR
EQUIPMENT: CONVEYOR (BULK HANDLING),

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Conveyor Lift, H (in mm):-					
Conveyor Length, L (in m):- 265500MM					
Conveyor Inclination, θ° (in Degree): 0°					
Wrap angle :- 210°					
High speed end Coupling :	Low speed end coupling :				
Type :-	Type :-				
Make :-	Make :-				
Size :-	Size :-				
Pulleys :					
Material :- MS	Lagging: - 12 mm thk and 6mm grooved. Neoprene for head pulley / drive pulleys (Diamond pattern) 12 mm thk. plain neoprene lagging for tail & other pulley				
Width, mm :-					
	<u>Head</u>	<u>Tail</u>	<u>Snub</u>	<u>Take-up</u>	<u>Bend</u>
Diameter, mm :-	800	630	630	630	630
Weight, Kg :-					
Shaft :					
Material :- EN-8					
Diameter, mm :-	<u>Head</u>	<u>Tail</u>	<u>Snub</u>	<u>Take-up</u>	<u>Bend</u>
At bearing :-					
At pulley :-					
Bearing :	<u>Head</u>	<u>Tail</u>	<u>Snub</u>	<u>Take-up</u>	<u>Bend</u>
Type & No.:- Heavy duty spherical Roller bearing					
Make :-					
Size :-					
Idlers :					
Make :-					
Material :- M.S					
Lagging thickness, mm :-	Lagging: - Min. 25 mm thk. Rubber lagging for Impact idlers (plain pattern).Lagging in Guide roller to be provided.				
	<u>Carrying side</u>			<u>Return side</u>	
Type :- Carrying	3 roll			Single roll	
Diameter, mm :-	152.4			152.4	
Spacing, mm :-	1200			3000	
Bearing type :-					
Type :- Impact roller					
Spacing, mm :- 300mm					
Training Idlers :					
Type :- Self aligning carrying idler	Decking Plates :- 4 m length at receiving end and 2m length at discharge end				
Diameter, mm :-	Material :- IS 2062				
Type :- Self aligning return idler					
Diameter, mm :-					

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	DATA SHEET: BELT CONVEYOR EQUIPMENT: CONVEYOR (BULK HANDLING),	PC0183	0
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Spacing, mm :-	Thickness, mm :- Min. 3.15	
Take-Up :-	Skirt Board :	
Type :- Gravity Take-up(Horizontal/Vertical)	Material :- IS 2062	
Weight, Kg :-	Length & Thickness: - min. 3 m long & 3 mm thick with 6 mm thk linear (sailhard / Tiscral etc.)	
Location :- Head side	Type :-	
Movement, mm :-		
Belt Cleaner :-	<u>External</u>	<u>Internal</u>
Type :-	Multi spring loaded type	V-type
Weight of complete conveyor, Kg :-		
REMARKS :- 1. This is a combined data sheet, contractor/bidder shall furnish filled in data sheet for each conveyor separately along with their offer.		

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REV	REV DATE	EFF DATE	PURPOSE	PREPD	REVWD	APPD



DATA SHEET: BELT CONVEYOR
EQUIPMENT: CONVEYOR (BULK HANDLING),

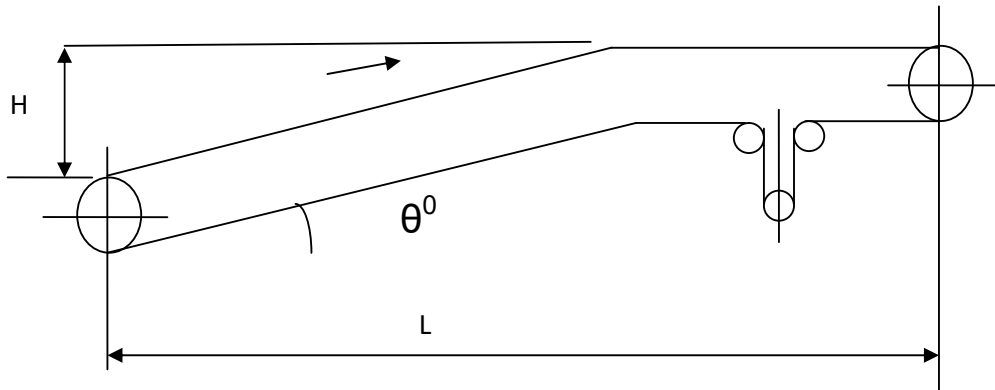
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LINE SKETCH (Refer attached layout Drawing)

APPLICATION DATA

Applicable to :- Handling of Coal / Petcoke / Limestone. Purchase Proposal

Date:

Conveyors: - BC-2A/2B,

Manufacturer :-

Quantity Required :- One No. each

Type :- Troughed, 3 equal rolls

Duty :- Continuous, 24 hrs/day

Troughing Angle :- 35°

Relative Humidity:- 100 % max.

Surrounding :- Dusty

Temperature :- Ambient

MATERIAL HANDLED DATA

Material :- Coal, Petcoke, Limestone.

Angle of Repose :- 30°~45°

Average Size, mm :- 100 / 30/ 200

Moisture:- 14.3 % max.

Max. Size, mm :- 200

Temperature :- ambient

Percentage of Large Pieces :- 3% Max., Occasional

Abrasiveness :- Mild

Bulk Density (T / m³) :- 0.8 (Coal), 0.86 (Pet coke), 1.3 (Limestone)

TECHNICAL SPECIFICATION

Capacity, Te / hr :

Electric Motor :

Normal/ Rated :- 1250TPH

Make & Type :- 3 phase squirrel induction motor

Peak :-

Rating, K.W :-

Design :- 1500TPH

Speed, R.P.M :-

Belt Speed, 3.0 m/sec

Reduction Gear Box :

Belt Specification :

Type :- Helical Gear Box

Belt width, mm :- 1400

Make :-

Rating :-

Frame size :-

Construction :- Nylon/Nylon

Reduction ratio :-

Make :-

Efficiency, Min :- 85%

Duty :- HD

Lubrication :-

Cover grades :- FR

Weight, Kg :-

Cover Thickness, mm :- Top : 5 Bottom : 3

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DATA SHEET: BELT CONVEYOR
EQUIPMENT: CONVEYOR (BULK HANDLING),

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Conveyor Lift, H (in mm):-					
Conveyor Length, L (in m):- 152000MM					
Conveyor Inclination, θ° (in Degree): 03 $^{\circ}$					
Wrap angle :- 210 $^{\circ}$					
High speed end Coupling :	Low speed end coupling :				
Type :-	Type :-				
Make :-	Make :-				
Size :-	Size :-				
Pulleys :					
Material :- MS	Lagging: - 12 mm thk and 6mm grooved. Neoprene for head pulley / drive pulleys (Diamond pattern) 12 mm thk. plain neoprene lagging for tail & other pulley				
Width, mm :-					
	<u>Head</u>	<u>Tail</u>	<u>Snub</u>	<u>Take-up</u>	<u>Bend</u>
Diameter, mm :-	800	630	630	630	630
Weight, Kg :-					
Shaft :					
Material :- EN-8					
Diameter, mm :-	<u>Head</u>	<u>Tail</u>	<u>Snub</u>	<u>Take-up</u>	<u>Bend</u>
At bearing :-					
At pulley :-					
Bearing :	<u>Head</u>	<u>Tail</u>	<u>Snub</u>	<u>Take-up</u>	<u>Bend</u>
Type & No.:- Heavy duty spherical Roller Bearing					
Make :-					
Size :-					
Idlers :					
Make :-					
Material :- M.S					
Lagging thickness, mm :-	Lagging: - Min. 25 mm thk. Rubber lagging for Impact idlers (plain pattern). Lagging in Guide roller to be provided.				
	<u>Carrying side</u>			<u>Return side</u>	
Type :- Carrying	3 roll			Single roll	
Diameter, mm :-	152.4			152.4	
Spacing, mm :-	1200			3000	
Bearing type :-					
Type :- Impact roller					
Spacing, mm :- 300mm					
Training Idlers :					
Type :- Self aligning carrying idler	Decking Plates :- 4 m length at receiving end and 2m length at discharge end				
Diameter, mm :-	Material :- IS 2062				
Type :- Self aligning return idler					

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	DATA SHEET: BELT CONVEYOR EQUIPMENT: CONVEYOR (BULK HANDLING),	PC0183	0
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Diameter, mm :-		
Spacing, mm :	Thickness, mm :- Min. 3.15	
Take-Up :-	Skirt Board :	
Type :- Gravity Take-up(Horizontal/Vertical)	Material :- IS 2062	
Weight, Kg :-	Length & Thickness: - min. 3 m long & 3 mm thick with 6 mm thk linear (sailhard / Tiscral etc.)	
Location :- Head side	Type :-	
Movement, mm :-		
Belt Cleaner :-	<u>External</u>	<u>Internal</u>
Type :-	Multi spring loaded type	V-type
Weight of complete conveyor, Kg :-		

REMARKS :-

1. This is a combined data sheet, contractor/bidder shall furnish filled in data sheet for each conveyor separately along with their offer.

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REV	REV DATE	EFF DATE	PURPOSE	PREPD	REVWD	APPD



DATA SHEET: BELT CONVEYOR
EQUIPMENT: CONVEYOR (BULK HANDLING),

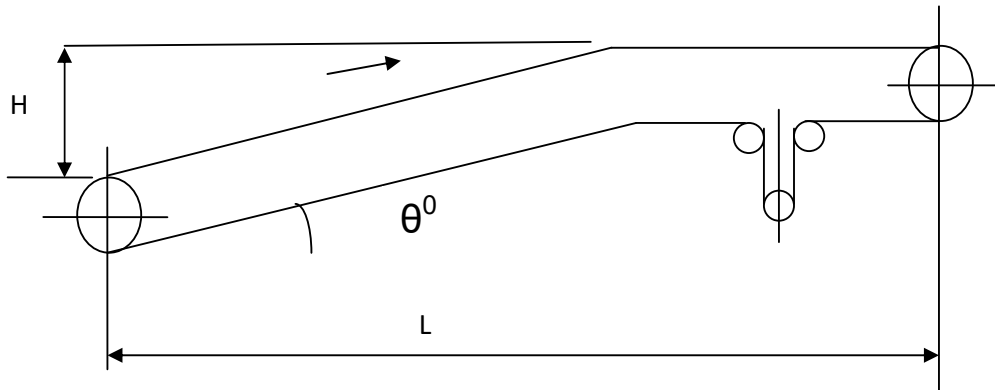
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LINE SKETCH (Refer attached layout Drawing)

APPLICATION DATA

Applicable to :- Handling of Coal / Petcoke / Limestone. Purchase Proposal

Date:

Conveyors: - BC-3A/3B, Series

Manufacturer :-

Quantity Required :- One No. each

Type :- Troughed, 3 equal rolls

Duty :- Continuous, 24 hrs/day

Troughing Angle :- 35°

Relative Humidity: - 100 % max.

Surrounding :- Dusty

Temperature :- Ambient

MATERIAL HANDLED DATA

Material :- Coal, Petcoke, Limestone.

Angle of Repose :- 30°-45°

Average Size, mm :- 100 / 30/ 200

Moisture: - 14.3 % max.

Max. Size, mm :- 200

Temperature :- ambient

Percentage of Large Pieces :- 3% Max., Occasional

Abrasiveness :- Mild

Bulk Density (T / m³) :- 0.8 (Coal), 0.86 (Pet coke), 1.3 (Limestone)

TECHNICAL SPECIFICATION

Capacity, Te / hr :

Electric Motor :

Normal/ Rated :- 1250TPH

Make & Type :- 3 phase squirrel induction motor

Peak :-

Rating, K.W :-

Design :- 1500TPH

Speed, R.P.M :-

Belt Speed :- 3.0 m/sec

Reduction Gear Box :

Belt Specification :

Type :- Helical Gear Box

Belt width, mm :- 1400

Make :-

Rating :-

Frame size :-

Construction :- Nylon/Nylon

Reduction ratio :-

Make :-

Efficiency, Min :- 85%

Duty :- HD

Lubrication :-

Cover grades :- FR

Weight, Kg :-

Cover Thickness, mm :- Top : 5 Bottom : 3

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DATA SHEET: BELT CONVEYOR
EQUIPMENT: CONVEYOR (BULK HANDLING),

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Conveyor Lift, H (in mm):-					
Conveyor Length, L (in m):- 45550 MM					
Conveyor Inclination, θ^0 (in Degree): 9 ⁰					
Wrap angle :- 210 ⁰					
High speed end Coupling :	Low speed end coupling :				
Type :-	Type :-				
Make :-	Make :-				
Size :-	Size :-				
Pulleys :					
Material :- MS	Lagging: - 12 mm thk and 6mm grooved. Neoprene for head pulley / drive pulleys (Diamond pattern) 12 mm thk. plain neoprene lagging for tail & other pulley				
Width, mm :-					
	<u>Head</u>	<u>Tail</u>	<u>Snub</u>	<u>Take-up</u>	<u>Bend</u>
Diameter, mm :-	800	630	630	630	630
Weight, Kg :-					
Shaft :					
Material :- EN-8					
Diameter, mm :-	<u>Head</u>	<u>Tail</u>	<u>Snub</u>	<u>Take-up</u>	<u>Bend</u>
At bearing :-					
At pulley :-					
Bearing :	<u>Head</u>	<u>Tail</u>	<u>Snub</u>	<u>Take-up</u>	<u>Bend</u>
Type & No.:- Heavy duty Spherical Roller Bearing					
Make :-					
Size :-					
Idlers :					
Make :-					
Material :- M.S					
Lagging thickness, mm :-	Lagging: - Min. 25 mm thk. Rubber lagging for Impact idlers (plain pattern). Lagging in Guide roller to be provided.				
	<u>Carrying side</u>			<u>Return side</u>	
Type :- Carrying	3 roll			Single roll	
Diameter, mm :-	152.4			152.4	
Spacing, mm :-	1200			3000	
Bearing type :-					
Type :- Impact roller					
Spacing, mm :- 300mm					
Training Idlers :					
Type :- Self aligning carrying idler	Decking Plates :- 4 m length at receiving end and 2m length at discharge end				
Diameter, mm :-	Material :- IS 2062				
Type :- Self aligning return idler					

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	DATA SHEET: BELT CONVEYOR EQUIPMENT: CONVEYOR (BULK HANDLING),	PC0183	0
		DOCUMENT NO	REV
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Diameter, mm :-		
Spacing, mm	Thickness, mm :- Min. 3.15	
Take-Up :-	Skirt Board :	
Type :- Gravity Take-up(Horizontal/Vertical)	Material :- IS 2062	
Weight, Kg :-	Length & Thickness: - min. 3 m long & 3 mm thick with 6 mm thk linear (sailhard / Tiscral etc.)	
Location :- Head side	Type :-	
Movement, mm :-		
Belt Cleaner :-	<u>External</u>	<u>Internal</u>
Type :-	Multi spring loaded type	V-type
Weight of complete conveyor, Kg :-		

REMARKS :-

1. This is a combined data sheet, contractor/bidder shall furnish filled in data sheet for each conveyor separately along with their offer.

0	14.03.23	14.03.23	Issued for Tender	AKS	AKS/NS	NS
REV	REV DATE	EFF DATE	PURPOSE	PREPD	REVWD	APPD



DATA SHEET: BELT CONVEYOR
EQUIPMENT: CONVEYOR (BULK HANDLING),

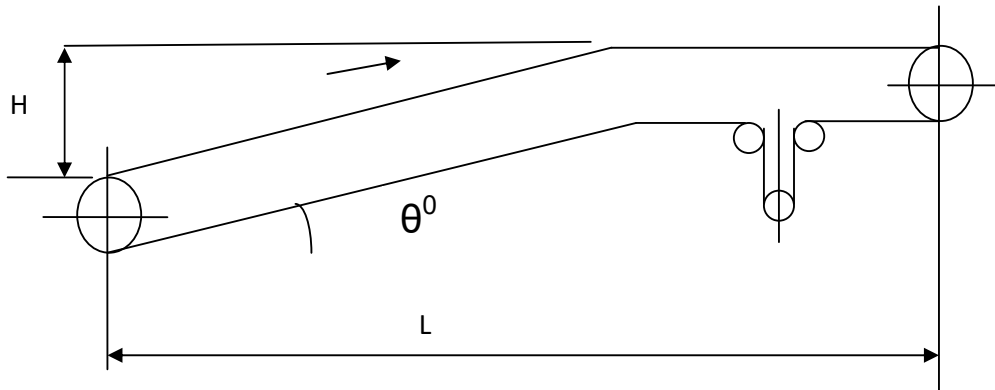
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LINE SKETCH (Refer attached layout Drawing)

APPLICATION DATA

Applicable to :- Handling of Coal / Petcoke / Limestone. Purchase Proposal

Date:

Conveyors: - BC-4A/4B,

Manufacturer :-

Quantity Required :- One No. each

Type :- Troughed, 3 equal rolls

Duty :- Continuous, 24 hrs/day

Troughing Angle :- 35°

Relative Humidity: - 100 % max.

Surrounding :- Dusty

Temperature :- Ambient

MATERIAL HANDLED DATA

Material :- Coal, Petcoke, Limestone.

Angle of Repose :- 30°~45°

Average Size, mm :- 100 / 30/ 200

Moisture: - 14.3 % max.

Max. Size, mm :-200

Temperature :- ambient

Percentage of Large Pieces :- 3% Max., Occasional

Abrasiveness :- Mild

Bulk Density (T / m³) :- 0.8 (Coal), 0.86 (Pet coke), 1.3 (Limestone)

TECHNICAL SPECIFICATION

Capacity, Te / hr :

Electric Motor :

Normal/ Rated :- 1250TPH

Make & Type :-3 phase squirrel induction motor

Peak :-

Rating, K.W :-

Design :- 1500TPH

Speed, R.P.M :-

Belt Speed:- 3.0 m/sec (Maximum)

Reduction Gear Box :

Belt Specification :

Type :- Helical Gear Box

Belt width, mm :- 1400

Make :-

Rating :-

Frame size :-

Construction :- Nylon/Nylon

Reduction ratio :-

Make :-

Efficiency, Min :- 85%

Duty :- HD

Lubrication :-

Cover grades :- FR

Weight, Kg :-

Cover Thickness, mm :- Top : 5 Bottom : 3

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DATA SHEET: BELT CONVEYOR
EQUIPMENT: CONVEYOR (BULK HANDLING),

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Conveyor Lift, H (in mm):-					
Conveyor Length, L (in m):- 514000MM					
Conveyor Inclination, θ° (in Degree): 3.06 ⁰					
Wrap angle :- 210 ⁰					
High speed end Coupling :	Low speed end coupling :				
Type :-	Type :-				
Make :-	Make :-				
Size :-	Size :-				
Pulleys :					
Material :- MS	Lagging: - 12 mm thk and 6mm grooved. Neoprene for head pulley / drive pulleys (Diamond pattern) 12 mm thk. plain neoprene lagging for tail & other pulley				
Width, mm :-					
	<u>Head</u>	<u>Tail</u>	<u>Snub</u>	<u>Take-up</u>	<u>Bend</u>
Diameter, mm :-	800	630	630	630	630
Weight, Kg :-					
Shaft :					
Material :- EN-8					
Diameter, mm :-	<u>Head</u>	<u>Tail</u>	<u>Snub</u>	<u>Take-up</u>	<u>Bend</u>
At bearing :-					
At pulley :-					
Bearing :	<u>Head</u>	<u>Tail</u>	<u>Snub</u>	<u>Take-up</u>	<u>Bend</u>
Type & No.:- Heavy Duty spherical Roller Bearing					
Make :-					
Size :-					
Idlers :					
Make :-					
Material :- M.S					
Lagging thickness, mm :-	Lagging: - Min. 25 mm thk. Rubber lagging for Impact idlers (plain pattern). Lagging in Guide roller to be provided.				
	<u>Carrying side</u>			<u>Return side</u>	
Type :- Carrying	3 roll			Single roll	
Diameter, mm :-	152.4			152.4	
Spacing, mm :-	1200			3000	
Bearing type :-					
Type :- Impact roller					
Spacing, mm :- 300mm					
Training Idlers :					
Type :- Self aligning carrying idler	Decking Plates :- 4 m length at receiving end and 2m length at discharge end				
Diameter, mm :-	Material :- IS 2062				
Type :- Self aligning return idler					

0	14.03.23	14.03.23	Issued for Tender	AKS	AKS/NS	NS
REV	REV DATE	EFF DATE	PURPOSE	PREPD	REVWD	APPD

	DATA SHEET: BELT CONVEYOR EQUIPMENT: CONVEYOR (BULK HANDLING),	PC0183	0
		DOCUMENT NO	REV
		SHEET 3 of 3	

Diameter, mm :-		
Spacing, mm :	Thickness, mm :- Min. 3.15	
Take-Up :-	Skirt Board :	
Type :- Gravity Take-up(Horizontal/Vertical)	Material :- IS 2062	
Weight, Kg :-	Length & Thickness: - min. 3 m long & 3 mm thick with 6 mm thk linear (sailhard / Tiscral etc.)	
Location :- Head side	Type :-	
Movement, mm :-		
Belt Cleaner :-	<u>External</u>	<u>Internal</u>
Type :-	Multi spring loaded type	V-type
Weight of complete conveyor, Kg :-		

REMARKS :-

1. This is a combined data sheet, contractor/bidder shall furnish filled in data sheet for each conveyor separately along with their offer.

0	14.03.23	14.03.23	Issued for Tender	AKS	AKS/NS	NS
REV	REV DATE	EFF DATE	PURPOSE	PREPD	REVWD	APPD



DATA SHEET: BELT CONVEYOR
EQUIPMENT: CONVEYOR (BULK HANDLING),

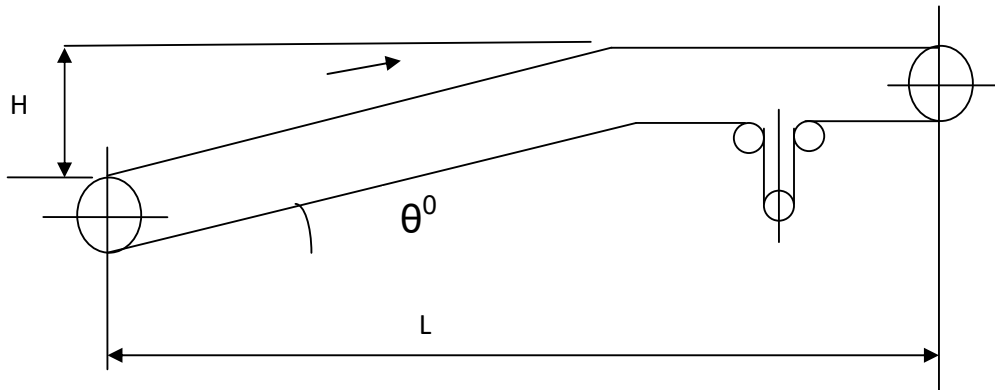
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LINE SKETCH (Refer attached layout Drawing)

APPLICATION DATA

Applicable to :- Handling of Coal / Petcoke / Limestone. Purchase
Proposal Date:

Conveyors: - BC-5A/5B,

Manufacturer :-

Quantity Required :- One No. each.

Type :- Troughed, 3 equal rolls

Duty :- Continuous, 24 hrs/day

Troughing Angle :- 35°

Relative Humidity: - 100 % max.

Surrounding :- Dusty

Temperature :- Ambient

MATERIAL HANDLED DATA

Material :- Coal, Petcoke, Limestone.

Angle of Repose :- 30°-45°

Average Size, mm :- 100 / 30/ 200

Moisture: - 14.3 % max.

Max. Size, mm :- 200

Temperature :- ambient

Percentage of Large Pieces :- 3% Max., Occasional

Abrasiveness :- Mild

Bulk Density (T / m³) :- 0.8 (Coal), 0.86 (Pet coke), 1.3 (Limestone)

TECHNICAL SPECIFICATION

Capacity, Te / hr :

Electric Motor :

Normal/ Rated :- 1250TPH

Make & Type :- 3 phase squirrel induction motor

Peak :-

Rating, K.W :-

Design :- 1500TPH

Speed, R.P.M :-

Belt Speed|-2.5 m/sec (Maximum)

Reduction Gear Box :

Belt Specification :

Type :- Helical Gear Box

Belt width, mm :- 1400

Make :-

Rating :-

Frame size :-

Construction :- Nylon/Nylon

Reduction ratio :-

Make :-

Efficiency, Min :- 85%

Duty :- HD

Lubrication :-

Cover grades :- FR

Weight, Kg :-

Cover Thickness, mm :- Top : 5 Bottom : 3

0	14.03.23	14.03.23	ISSUED FOR TENDER	AKS	AKS/NS	NS
REV	REV DATE	EFF DATE	PURPOSE	PREPD	REVWD	APPD



DATA SHEET: BELT CONVEYOR
EQUIPMENT: CONVEYOR (BULK HANDLING),

PC0183

0

DOCUMENT NO

REV

SHEET 2 of 3

Conveyor Lift, H (in mm):-					
Conveyor Length, L (in m):- 245000MM					
Conveyor Inclination, θ° (in Degree): 1.6 ⁰					
Wrap angle :- 210 ⁰					
High speed end Coupling :	Low speed end coupling :				
Type :-	Type :-				
Make :-	Make :-				
Size :-	Size :-				
Pulleys :					
Material :- MS	Lagging: - 12 mm thk and 6mm grooved. Neoprene for head pulley / drive pulleys (Diamond pattern) 12 mm thk. plain neoprene lagging for tail & other pulley				
Width, mm :-					
	<u>Head</u>	<u>Tail</u>	<u>Snub</u>	<u>Take-up</u>	<u>Bend</u>
Diameter, mm :-	800	630	630	630	630
Weight, Kg :-					
Shaft :					
Material :- EN-8					
Diameter, mm :-	<u>Head</u>	<u>Tail</u>	<u>Snub</u>	<u>Take-up</u>	<u>Bend</u>
At bearing :-					
At pulley :-					
Bearing :	<u>Head</u>	<u>Tail</u>	<u>Snub</u>	<u>Take-up</u>	<u>Bend</u>
Type & No.:- Heavy duty Spherical Roller Bearing					
Make :-					
Size :-					
Idlers :					
Make :-					
Material :- M.S					
Lagging thickness, mm :-	Lagging: - Min. 25 mm thk. Rubber lagging for Impact idlers (plain pattern). Lagging in Guide roller to be provided.				
	<u>Carrying side</u>			<u>Return side</u>	
Type :- Carrying	3 roll			Single roll	
Diameter, mm :-	152.4			152.4	
Spacing, mm :-	1200			3000	
Bearing type :-					
Type :- Impact roller					
Spacing, mm :- 300mm					
Training Idlers :					
Type :- Self aligning carrying idler	Decking Plates :- 4 m length at receiving end and 2m length at discharge end				
Diameter, mm :-	Material :- IS 2062				
Type :- Self aligning return idler					

0	14.03.23	14.03.23	ISSUED FOR TENDER	AKS	AKS/NS	NS
REV	REV DATE	EFF DATE	PURPOSE	PREPD	REVWD	APPD

	DATA SHEET: BELT CONVEYOR EQUIPMENT: CONVEYOR (BULK HANDLING),	PC0183	0
		DOCUMENT NO	REV
		SHEET 3 of 3	

Diameter, mm :-		
Spacing, mm :-10000mm	Thickness, mm :- Min. 3.15	
Take-Up :-	Skirt Board :	
Type :- Gravity Take-up(Horizontal/Vertical)	Material :- IS 2062	
Weight, Kg :-	Length & Thickness: - min. 3 m long & 3 mm thick with 6 mm thk linear (sailhard / Tiscral etc.)	
Location :- Head side	Type :-	
Movement, mm :-		
Belt Cleaner :-	<u>External</u>	<u>Internal</u>
Type :-	Multi spring loaded type	V-type
Weight of complete conveyor, Kg :-		
REMARKS :- 1. This is a combined data sheet, contractor/bidder shall furnish filled in data sheet for each conveyor separately along with their offer.		

0	14.03.23	14.03.23	ISSUED FOR TENDER	AKS	AKS/NS	NS
REV	REV DATE	EFF DATE	PURPOSE	PREPD	REVWD	APPD



DATA SHEET: BELT CONVEYOR
EQUIPMENT: CONVEYOR (BULK HANDLING),

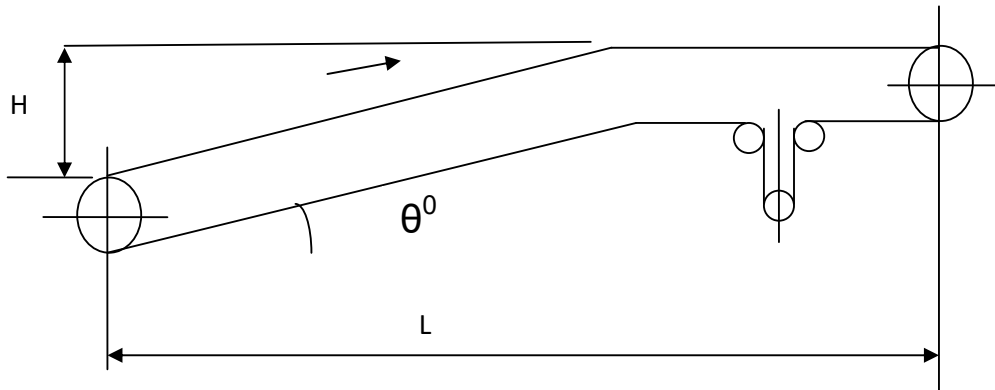
PC0183

0

DOCUMENT NO

REV

SHEET 1 of 3



LINE SKETCH (Refer attached layout Drawing)

APPLICATION DATA

Applicable to :- Handling of Coal / Petcoke / Limestone. Purchase Proposal

Date:

Conveyors: - BC-6A/6B

Manufacturer :-

Quantity Required: - one no. of each.

Type :- Troughed, 3 equal rolls

Duty :- Continuous, 24 hrs/day

Troughing Angle :- 35°

Relative Humidity: - 100 % max.

Surrounding :- Dusty

Temperature :- Ambient

MATERIAL HANDLED DATA

Material :- Coal, Petcoke, Limestone.

Angle of Repose :- 30°-45°

Average Size, mm :- 100 / 30/ 200

Moisture: - 14.3 % max.

Max. Size, mm :- 200

Temperature :- ambient

Percentage of Large Pieces :- 3% Max., Occasional

Abrasiveness :- Mild

Bulk Density (T / m³) :- 0.8 (Coal), 0.86 (Pet coke), 1.3 (Limestone)

TECHNICAL SPECIFICATION

Capacity, Te / hr :

Electric Motor :

Normal/ Rated :- 1250TPH

Make & Type :- 3 phase squirrel induction motor

Peak :-

Rating, K.W :-

Design :- 1500TPH

Speed, R.P.M :-

Belt Speed:- 3.0 m/sec

Reduction Gear Box :

Belt Specification :

Type :- Helical Gear Box

Belt width, mm :- 1400

Make :-

Rating :-

Frame size :-

Construction :- Nylon/Nylon

Reduction ratio :-

Make :-

Efficiency, Min :- 85%

Duty :- HD

Lubrication :-

Cover grades :- FR

Weight, Kg :-

Cover Thickness, mm :- Top : 5 Bottom : 3

0	14.03.23	14.03.23	Issued for Tender	AKS	AKS/NS	NS
REV	REV DATE	EFF DATE	PURPOSE	PREPD	REVWD	APPD



DATA SHEET: BELT CONVEYOR
EQUIPMENT: CONVEYOR (BULK HANDLING),

PC0183

0

DOCUMENT NO

REV

SHEET 2 of 3

Conveyor Lift, H (in mm):-					
Conveyor Length, L (in m):- 380000MM					
Conveyor Inclination, θ° (in Degree): 2.41 ⁰					
Wrap angle :- 210 ⁰					
High speed end Coupling :	Low speed end coupling :				
Type :-	Type :-				
Make :-	Make :-				
Size :-	Size :-				
Pulleys :					
Material :- MS	Lagging: - 12 mm thk and 6mm grooved. Neoprene for head pulley / drive pulleys (Diamond pattern) 12 mm thk. plain neoprene lagging for tail & other pulley				
Width, mm :-					
	<u>Head</u>	<u>Tail</u>	<u>Snub</u>	<u>Take-up</u>	<u>Bend</u>
Diameter, mm :-	800	630	630	630	630
Weight, Kg :-					
Shaft :					
Material :- EN-8					
Diameter, mm :-	<u>Head</u>	<u>Tail</u>	<u>Snub</u>	<u>Take-up</u>	<u>Bend</u>
At bearing :-					
At pulley :-					
Bearing :	<u>Head</u>	<u>Tail</u>	<u>Snub</u>	<u>Take-up</u>	<u>Bend</u>
Type & No.:- Heavy Duty Spherical Roller Bearing					
Make :-					
Size :-					
Idlers :					
Make :-					
Material :- M.S					
Lagging thickness, mm :-	Lagging: - Min. 25 mm thk. Rubber lagging for Impact idlers (plain pattern). Lagging in Guide roller to be provided.				
	<u>Carrying side</u>			<u>Return side</u>	
Type :- Carrying	3 roll			Single roll	
Diameter, mm :-	152.4			152.4	
Spacing, mm :-	1200			3000	
Bearing type :-					
Type :- Impact roller					
Spacing, mm :- 300mm					
Training Idlers :					
Type :- Self aligning carrying idler	Decking Plates :- 4 m length at receiving end and 2m length at discharge end				
Diameter, mm :-	Material :- IS 2062				
Type :- Self aligning return idler					

0	14.03.23	14.03.23	Issued for Tender	AKS	AKS/NS	NS
REV	REV DATE	EFF DATE	PURPOSE	PREPD	REVWD	APPD

	DATA SHEET: BELT CONVEYOR EQUIPMENT: CONVEYOR (BULK HANDLING),	PC0183	0
		DOCUMENT NO	REV
		SHEET 3 of 3	

Diameter, mm :-		
Spacing, mm	Thickness, mm :- Min. 3.15	
Take-Up :-	Skirt Board :	
Type :- Gravity Take-up(Horizontal/Vertical)	Material :- IS 2062	
Weight, Kg :-	Length & Thickness: - min. 3 m long & 3 mm thick with 6 mm thk linear (sailhard / Tiscral etc.)	
Location :- Head side	Type :-	
Movement, mm :-		
Belt Cleaner :-	<u>External</u>	<u>Internal</u>
Type :-	Multi spring loaded type	V-type
Weight of complete conveyor, Kg :-		

REMARKS :-

1. This is a combined data sheet, contractor/bidder shall furnish filled in data sheet for each conveyor separately along with their offer.

0	14.03.23	14.03.23	Issued for Tender	AKS	AKS/NS	NS
REV	REV DATE	EFF DATE	PURPOSE	PREPD	REVWD	APPD

	DATA SHEET: WAGON TIPPLER	PC0183	0
		DOCUMENT NO	REV
		SHEET 1 of 1	

Equipment Name:- Wagon tippler	Quantity Required :- One
---------------------------------------	---------------------------------

APPLICATION DATA

Applicable To :- <input type="checkbox"/> Proposal <input type="checkbox"/> Purchase <input type="checkbox"/> As Built		
Service: - Wagon unloading	Make & Model :- To be designed as per RDSO guideline G33 Rev 1	
Type of wagon:- BOXN/BOXNHA/BOXNHS and other applicable wagons used in Talcher Region for wagon tippler.	Capacity : -	
Type :- Single, Qty-1 no.	Relative Humidity: - 100% (Max.)	
Duty :- 24 hrs/day (continuous)	Surroundings :- Dusty	
Temperature :- Ambient	Use:- Indoor	

MATERIAL HANDLED DATA

Material: - Coal, Petcoke, Limestone.	Bulk Density (T / m³) :- 0.8(Coal),0.86(Pet coke),1.3 (Limestone)
Size(Min-Max)mm:- 30-200	Moisture: - 0.5 % max.
Average Size, mm :- 30-200	Max. Size, mm :- 200
Temperature :- 50°	Abrasiveness :- Mild

TECHNICAL SPECIFICATION


Capacity:-	Type of drive arrangement:- Hydraulic motor	
Normal/ Rated :- 25 Tips per hour	Make & Type :-	
Type of clamping :- Hydraulic		
Rail gauge :- 1676 mm	Angle of tipping	
Hopper capacity:-	Synchronising with: Apron feeder	
Experience and details:-	Plant-1:-	Plant-2:-
Details of Installation (address & year of Commissioning)		
Quantity & Capacity		
Parameters - belt width, - belt capacity (TPH)		
Certificate from client Enclosed	Yes/No	Yes/No

CONSTRUCTIONAL FEATURES

Lubrication :-	
Control :-	
Total Wt. of Complete machine, Kg :-	Overall Dimensions, mm. :-

MATERIAL OF CONSTRUCTION :-
REMARKS:- Contractor/bidder shall furnish filled in data sheet along with their offer.

0	14.03.23	14.03.23	ISSUED FOR TENDER	AKS	AKS/NS	NS
REV	REV DATE	EFF DATE	PURPOSE	PREPD	REVWD	APPD

	DATA SHEET: SIDE ARM CHARGER	PC0183	0
		DOCUMENT NO	REV
		SHEET 1 of 1	

Equipment Name:- Side arm charger	Quantity Required :- One
--	---------------------------------

APPLICATION DATA

Applicable To :- <input type="checkbox"/> Proposal <input type="checkbox"/> Purchase <input type="checkbox"/> As Built	
Service :- wagon positioning at the Wagon tippler for unloading of materials. Pushing / pulling a rake of 58 wagons and TWO LOCO ENGINE.	Make & Model :-
Type :- With hydraulic travel drive and Hydraulically operated coupling /de-coupling arm.	Relative Humidity: - 100% (Max.)
Duty :- Continuous, 24 hrs/day	Surroundings :- Dusty
Temperature :- Ambient	Use:- Outdoor

MATERIAL HANDLED DATA

Wagon to :- BOX/BOXN/BOXN HA/BOXNHS /BOXNEL	
--	--

TECHNICAL SPECIFICATION

Capacity, TPH :-	Type of drive arrangement:-
Range of travel:-	Synchronising with:- Wagon tippler
Type of drive: - With hydraulic travel drive and hydraulically operated coupling / decoupling arm.	Noise Level :- < 85 dBA.
No. of wagons to be pushed:- 59 wagons fully loaded pulled/ (Gross load 6000t min.)	Draw bar pull:-
Speed: -	Mode of control :-
Duty:- 24 hrs/day (continuous)	Power supply :-
Travel Drive : Hydraulic motor driven through power packs, positive driven through rackand pinion.	Lubrication :-

CONSTRUCTIONAL FEATURES

Total Wt. of Complete machine, Kg :-	Overall Dimensions, mm. :-
---	-----------------------------------

MATERIAL OF CONSTRUCTION :-

REMARKS:- Contractor/bidder shall furnish filled in data sheet along with their offer.

0	14.03.23	14.03.23	ISSUED FOR TENDER	AKS	AKS/NS	NS
REV	REV DATE	EFF DATE	PURPOSE	PREPD	REVWD	APPD

	DATA SHEET: APRON FEEDER		PC0183	0
			DOCUMENT NO	REV
			SHEET 1 of 1	

Equipment Name:- Apron feeder	Quantity Required :- One
--------------------------------------	---------------------------------

APPLICATION DATA

Applicable To :- <input type="checkbox"/> Proposal <input type="checkbox"/> Purchase <input type="checkbox"/> As Built		
Service: - Receiving large feed size material.	Make & Model :-	
Type :- Horizontal	Relative Humidity: - 100% (Max.)	
Duty :- Continuous, 24 hrs/day	Surroundings :- Dusty	
Temperature :- Ambient	Use:- Indoor	

MATERIAL HANDLED DATA

Material: - Coal, Petcoke, Limestone.	Bulk Density (T / m³) :- 0.8(Coal),0.86(Pet coke),1.3(Limestone)
Size(Min-Max)mm:-- 30-200	Moisture: - 14.3 % max.
Average Size, mm :- 30-200	Max. Size, mm :- 200
Temperature :- 50°	Abrasiveness :- Mild

TECHNICAL SPECIFICATION

Capacity, TPH : -	Drive:- VFD Drive to control flow rate of three different material (coal, Petcoke and Limestone)
Normal/ Rated :- 1250TPH	Make & Type :-
Peak :-	Rating, K.W :-
Design :- 1500TPH	Speed, R.P.M :-
Speed/sec :- As per system requirement.	Reduction Gear Box :-
Pan width, mm :-	Type :- Helical Gear Box
Material of construction of pan:-	Make :-
Length(Min-Max):-	Frame Size :-
Feeder size:-	Synchronising with: - Downstream Conveyors-BC-2A/2B.
Chain:-	Noise Level :- < 85 dBA.
Chain link:-	Percentage of Large Pieces :- 3% Max., Occasional
Drive sprocket:-	Chain Take up:-
Bed depth:-	Skirt width:-

CONSTRUCTIONAL FEATURES

Lubrication :-	
Control :-	
Total Wt. of Complete machine, Kg :-	Overall Dimensions, mm. :-

MATERIAL OF CONSTRUCTION: - As per vendor specification.

REMARKS: - Contractor/bidder shall furnish filled in data sheet along with their offer.

0	14.03.23	14.03.23	ISSUED FOR TENDER	AKS	AKS/NS	NS
REV	REV DATE	EFF DATE	PURPOSE	PREPD	REVWD	APPD

	DATA SHEET: PADDLE FEEDER		PC-0183	0
			DOCUMENT NO	REV
			SHEET	1 of 1

Equipment Name:- Paddle feeder	Quantity Required :- Four
---------------------------------------	----------------------------------

APPLICATION DATA

Applicable To :- <input type="checkbox"/> Proposal <input type="checkbox"/> Purchase <input type="checkbox"/> As Built	
Service: - Receiving large feed size material.	Make & Model :-
Type :-	Relative Humidity: - 100% (Max.)
Duty :- Continuous, 24 hrs/day	Surroundings :- Dusty
Temperature :- Ambient	Use:- Indoor

MATERIAL HANDLED DATA

Material: - Coal, Petcoke, Limestone.	Bulk Density (T / m³) :- 0.8(Coal),0.86(Pet coke),1.3(Limestone)
Size(Min-Max)mm:-- 30-200	Moisture: - 14.3 % max.
Average Size, mm :- 30-200	Max. Size, mm :- 200
Temperature :- 50°	Abrasiveness :- Mild

TECHNICAL SPECIFICATION

Capacity, TPH :-	Type of drive arrangement:- VFD Drive to control flow rate of three different material (coal, Petcoke and Limestone)
Normal/ Rated :- 1000TPH	Make & Type :-
Design :- 1200TPH	Rating, K.W :-
Capacity adjustment range:-	Speed, R.P.M :-
Paddle Wheel:-	Reduction Gear Box :-
Diameter of wheel:-	Type :-
Number of vanes:-	Make :-
Material of vane:-	Frame Size :-
Material for vane liner:-	Synchronising with:- ConvBC-1A/1B
Travel length(Min-Max):-	Noise Level :- < 85 dBA.
	Percentage of Large Pieces :- 3% Max., Occasional
Feeder Carriage:-	Type of drive Arrangement:-
	Motor nameplate rating KW at 50 deg.C Ambient:-


CONSTRUCTIONAL FEATURES

Lubrication :-	
Control :-	
Total Wt. of Complete machine, Kg :-	Overall Dimensions, mm. :-

MATERIAL OF CONSTRUCTION :-

REMARKS: - Contractor/bidder shall furnish filled in data sheet along with their offer.

0	14.03.23	14.03.23	ISSUED FOR TENDER	AKS	AKS/NS	NS
REV	REV DATE	EFF DATE	PURPOSE	PREPD	REVWD	APPD

	DATA SHEET: Belt scale		PC0183	0
			DOCUMENT NO	REV
			SHEET 1 of 1	

Equipment Name:- Belt scale	Quantity Required :- Two
------------------------------------	---------------------------------

APPLICATION DATA

Applicable To :- <input type="checkbox"/> Proposal <input type="checkbox"/> Purchase <input type="checkbox"/> As Built		
Service :-	Make & Model :-	
Type :-	Relative Humidity: - 100% (Max.)	
Duty :- Continuous, 24 hrs/day	Surroundings :- Dusty	
Location:- Conv-BC-3A/3B		
Temperature :- Ambient	Use:- Outdoor	

MATERIAL HANDLED DATA

Material :- Coal,Petcoke,Limestone.	Average Size, mm :- 30-200
--	-----------------------------------

TECHNICAL SPECIFICATION

Belt width:- 1400mm	
Measuring capacity, TPH :- 1500TPH	Accuracy (%) -
Max. MTPH:-	At maximum load:-
Min. MTPH:-	At minimum load:-
Rate Indicators provided:- Yes/No	
Totaliser:-	
Provided:- Yes/No	


CONSTRUCTIONAL FEATURES

Total Wt. of Complete machine, Kg :-	Overall Dimensions, mm. :-
---	-----------------------------------

MATERIAL OF CONSTRUCTION :-

REMARKS:- Contractor/bidder shall furnish filled in data sheet along with their offer.

0	14.03.23	14.03.23	ISSUED FOR TENDER	AKS	AKS/NS	NS
REV	REV DATE	EFF DATE	PURPOSE	PREPD	REVWD	APPD

	DATA SHEET: In-line Magnetic separators and	PC0183	0
		DOCUMENT NO	REV
		SHEET 1 of 1	

Equipment Name:- In-line Magnetic separators and suspended magnets.	Quantity Required :- 2 + 4
--	-----------------------------------

APPLICATION DATA

Applicable To :- <input type="checkbox"/> Proposal <input type="checkbox"/> Purchase <input type="checkbox"/> As Built	
Service :-	Make & Model :-
Type :-	Relative Humidity: - 100% (Max.)
Duty :- Continuous, 24 hrs/day	Surroundings :- Dusty
Location:- Conv-BC-1A/1B, BC-2A/2B, BC-6A/6B,	Use:- Indoor
Temperature :- Ambient	

MATERIAL HANDLED DATA

Material: - Coal, Petcoke, Limestone.	Average Size, mm :- 30-200
--	-----------------------------------

TECHNICAL SPECIFICATION

Belt width:- 1400mm	
Mounting height, mm:-	Strength in gauss at mounting height:-
Magnet:-	
Type:-	Material of magnet core:-
Material of coil:-	Class of insulation:-
KW rating at 50 deg.C Ambient:-	Self-Cleaning Belt provided for In Line Magnetic Separator :- Yes/No

CONSTRUCTIONAL FEATURES

Total Wt. of Complete machine, Kg :-	Overall Dimensions, mm. :-
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MATERIAL OF CONSTRUCTION :-

REMARKS: - Contractor/bidder shall furnish filled in data sheet along with their offer.
--

0	14.03.23	14.03.23	ISSUED FOR TENDER	AKS	AKS/NS	NS
REV	REV DATE	EFF DATE	PURPOSE	PREPD	REVWD	APPD

 पी डी आई एल PDIL	PROJECTS & DEVELOPMENT INDIA LTD	PC183/4018/SecVI/3.1.2	0	 Talcher Fertilizers
		DOCUMENT NO	REV	
		SHEET 1 OF 2		

DESIGN PHILOSOPHY – ROTATING EQUIPMENTS

ROM COAL/PETCOKE/LIMESTONE HANDLING FROM RAILWAY SIDING TO STORAGE YARD

**PROJECT: INTEGRATED COAL BASED FERTILISER COMPLEX,
AT TALCHER, ANGUL DISTRICT, ODISHA (INDIA)**

 पी डी आई एल PDIL	PROJECTS & DEVELOPMENT INDIA LTD.	PC183/4018/SecVI/3.1.2	0	
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TABLE OF CONTENTS

SL. NO.	DESCRIPTION
1.0	SCOPE
2.0	DESIGN PHILOSOPHY FOR MACHINERY
3.0	DESIGN REQUIREMENTS
4.0	INSPECTION AND TESTING
5.0	PAINTING

LIST OF ATTACHMENTS

ATTACHMENT NUMBER	DESCRIPTION	NUMBER OF SHEETS
ANNEXURE - 1	INSPECTION & TESTING GUIDE LINES – ROTATING EQUIPMENT	2

	ROM COAL/PETCOKE/LIMESTONE HANDLING FROM RAILWAY SIDING TO STORAGE YARD TFL, ODISHA DESIGN PHILOSOPHY – ROTATING EQUIPMENTS	PC183/4018/SecVI/3.1.2	0	
		Document No.	Rev	
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1.0 SCOPE

1.1 General

This Philosophy states that contractor's scope of work shall include basic & detailed engineering, procurement, supply, manufacturing, fabrication, transportation, loading, unloading, insurance during transit, storage, construction, erection/ installation of all **Mechanical Rotating Equipment** with allied electrical & instrumentation excluding civil works, obtaining all necessary statutory approvals from concerned government authorities as applicable, testing, mechanical completion, pre-commissioning, commissioning, performance guarantee test runs including total project management and handing over of WAGON UNLOADING PACKAGE of prescribed capacity for **M/s Talcher Fertiliser Ltd. (TFL)**.

In addition, all statutory rules & regulations shall also be complied with.

2.0 DESIGN PHILOSOPHY FOR MACHINERY

2.1 Codes and Standards

Latest Edition of National / international codes and standards shall be followed for design and manufacturing of different machinery items. Generally the manufacturer will comply with these codes and standards with minor deviations that are normally adopted by manufacturer and are reasonably accepted as per good engineering practice by owner.

A list of such deviations, if any, shall be furnished by the LSTK Contractor / Packager / Packager/ Packager along with offer.

Code	Description
API 610	Centrifugal Pumps for Petroleum, Petrochemical and Natural Gas Industry
ANSI/ ASME B 73.1 M	Horizontal, End Suction centrifugal Pumps for Chemical Process
International Standard	Horizontal Centrifugal Pumps for Clear Cold Water
API 611	General-Purpose Steam Turbines for Refinery Service.
API 612	Petroleum, Petrochemical and Natural Gas Industries Steam Turbine - Special Purpose application
API 613	Special Purpose Gear Units for Petroleum, Chemical and Gas Industry Services
API 614	Lubrication, Shaft-Sealing, and Control Oil System for Petroleum, Chemical and Gas Industry Services
API 616	Gas Turbine for Petroleum, Chemical and Gas Industry Services
API 617	Axial, Centrifugal Compressors and Expander Compressor

	ROM COAL/PETCOKE/LIMESTONE HANDLING FROM RAILWAY SIDING TO STORAGE YARD TFL, ODISHA DESIGN PHILOSOPHY – ROTATING EQUIPMENTS	PC183/4018/SecVI/3.1.2	0	
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	for Petroleum, Chemical and Gas Industry Services
API 618	Reciprocating Compressors for Petroleum, Chemical and Gas Industry Services
API 619	Rotary Type Positive Displacement Compressors for General Refinery Services.
API 670	Vibration, Axial-Position, and Bearing- Temperature Monitoring Systems.
API 671	Special Purpose Coupling for Refinery Services, Petrochemical and Gas Industry .
API 673	Special Purpose Centrifugal Fans for General Refinery Services.
API 674	Positive Displacement Pumps-Reciprocating
API 675	Positive Displacement Pumps-Controlled Volume
API 676	Positive Displacement Pumps-Rotary.
API 678	Accelerometer and Vibration Systems.
API 682	Shaft sealing Systems for Centrifugal and Rotary Pumps.
API 685	Sealless Pump (Magnetic & Canned)
ISO / DIN	Centrifugal Pumps for smaller size & Non Critical Services.
International Standard, ASHRAE / ISHRAE	HVAC
<u>Performance Testing (ASME Codes)</u>	
PTC 8.2	Centrifugal Pump
PTC 6	Steam Turbines
PTC 9	Displacement Compressors
PTC 10	Centrifugal Compressors
PTC 11	Centrifugal Fans
PTC 22	Gas Turbines
<u>AGMA Standard</u>	
420	Practise for Enclosed Reducers or Increasesers using Spur, Helical, Herringbone and Spiral Bevel Gears.
421	Practise for High Speed Helical Gear Units.
<u>NEMA Standards</u>	
SM 23	Steam Turbine for Mechanical Drive Service.

	ROM COAL/PETCOKE/LIMESTONE HANDLING FROM RAILWAY SIDING TO STORAGE YARD TFL, ODISHA DESIGN PHILOSOPHY – ROTATING EQUIPMENTS	PC183/4018/SecVI/3.1.2	0	
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2.2 Design Life

All equipment shall be designed for a minimum service life of 25 years and at least 2 years of uninterrupted operation under normal operating conditions. This requirement excludes specialised components requiring periodic maintenance and replacement.

2.3 Essential Project Reference Documents

The following documents shall be observed, and relevant aspects incorporated into specifications and datasheets:

- Process Description, Specifications and Data Sheets.
- Hazardous Area Classification
- Electrical and Instrumentation Design Criteria

2.4 Regulations

Besides codes & standards, LSTK Contractor / Packager shall follow National Laws and Regulations together with Local by Laws for the state including statutory requirements as applicable.

2.5 Site Conditions

Site conditions shall be as defined elsewhere.

2.6 Material of Construction

Generally Materials of construction shall be as per the process part of NIT.

Use of equivalent & superior material may be selected & shall be furnished with the offer along with chemical composition.

2.7 Quality Assurance & Control

2.7.1 The quality assurance shall be as per the approved procedures, test methods & facilities to be developed by the LSTK Contractor / Packager to ensure that the supplied equipment shall be of highest quality. The quality control shall mean that all the tests, measurements, checks & calibration which are to be carried out may be compared with the actual specified characteristics of the equipments/unit /system.

2.7.2 Quality Assurance (QA) shall mean the organizational set up, procedures as well as test methods and facilities developed by LSTK Contractor / Packager in order to assure that the machines & associated auxiliaries leaving LSTK Contractor's shop are of the highest possible quality i.e. either equal to or better than the requirement specified.

2.7.3 Quality Control (QC), shall mean all the tests, measurement, checks and calibration which are to be carried out in LSTK Contractor's shop in order to compare the actual characteristics of the equipment/unit/system with the specified ones, along with furnishing of the relevant documentation (certificates/records) containing the data or result of these activities.

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2.7.4 LSTK Contractor/ Packager shall submit a comprehensive description (manual) of QA/QC measures contemplated by him for implementation with regard to this specification. It is contractual obligation of the LSTK Contractor / Packager / Packager to develop and implement adequate QA/QC systems.

2.7.5 QA/QC system shall cover all products and services required for the complete machine unit as per scope of work including job sub contracted by the LSTK Contractor.

2.8 Order of precedence:

In case of any ambiguity found w.r.t details of Rotating equipments, following order of precedence (in order of priority) shall be followed:

1. Process Datasheet of rotating equipment
2. Applicable Codes & Standards referred in this Design philosophy
3. This Design philosophy document.

3.0 DESIGN REQUIREMENTS

3.1 General

- All machines shall be directly coupled to their prime movers. V-Belt driven system is not preferred. If not, specifically mentioned, the drivers shall have rated output at least 10% greater than the power requirement at design operating condition of the driven equipment.
- Copper (Cu) or Cu-alloy shall not be used for any components.
- All type of pumps/Agitator/Rotating equipments shall have Mechanical Seals. Seal manufacturer recommendation may be asked as per applicability. Gland packing shall not be acceptable.
- Special tools and wrenches required for installation and maintenance shall be provided.
- Noise level for all rotating equipment shall be limited to 85 dBA measured at 1 meter distance from the equipment.
- For approval of additional vendor (other than list enclosed with the NIT) during detail engineering stage, Packager/contractors first shall submit regret letters of registered vendors. Upon acceptance of same, packager/contractors shall submit proposed vendor along with the reference list for similar equipment's models (minimum 2 nos.) supplied in past for similar duty conditions. Reference list must contain at least the following: Fluid handled Capacity, Suction Pressure, Discharge Pressure, Model No., Power consumption, Client Name, Address, and Year of supply.
- All running equipment shall have a stand-by unit installed.
- Rotary equipment base frame is to be grouted by epoxy grout.

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- Pump alignment to be done by Laser and alignment machine to be handed over to client after completion of project.
- All the pumps & its component shall be completely API complaint, all pumps seals shall be as per API 682 latest edition duly recommended by reputed Seal manufacturer.

3.2 Centrifugal compressors

- The centrifugal compressors shall conform to API 617, latest edition. In addition, following points shall be applicable:
 - All machines shall have stable operating characteristics. The head generated shall rise continuously from choke point to surge point.
 - The manufacturer's criteria for suction and discharge piping shall be incorporated into the piping design and layout.
 - Torsional and lateral critical speed analysis shall be carried out and it shall be ensured that no critical speed (Torsional or lateral) shall be within 15% of any operating speed.
 - Casings shall be preferably centre line supported.
 - Vertical split (Barrel type) compressors shall have the inner casing designed for easy withdrawal from the outer shell and easy reassembly for inspection or replacement of parts.
 - Impellers shall be welded or electrochemically eroded. Tip speed of the impeller shall not exceed 310 m/s.
 - Diaphragm type coupling of proven make like Bendix shall be used. The couplings shall be designed as per API-671.
 - Dry Gas seals shall be provided for centrifugal compressors except for Process Air & CO2 compressor.
 - Combined lubrication and seal oil system (as applicable) shall be provided as per API 614 (latest edition) for each compressor and drive turbine. All the lube oil piping shall be made of SS.
 - Twin oil cooler and twin oil filter shall be provided.
 - For machines with oil seals, two seal oil traps shall be provided with each casing - one for each seal. These traps shall be sized and interconnected so that each trap is capable of accepting the flow from both the seals while one trap is removed for maintenance.
 - Complete Anti-Surge control system with computerised calculations with compressor characteristics shall be provided for each machine.
 - Shaft vibration monitoring instruments (both radial and axial) shall be provided to trip the machine in case of high radial vibration or axial movement.
 - All the trip interlock shall be two out of three voting logic.
 - All the transmitters shall be smart type and suitable for communication with DCS.

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3.3 Reciprocating Compressors

- The reciprocating compressors shall conform to API-618, latest edition. In addition to the above, the following shall be applicable:
 - Lateral and torsional critical speed analysis shall be carried out to ensure the elimination of any lateral and torsional vibration that may hinder the operating speed range.
 - Machine shall be balanced to minimise lateral loads.
 - The piston speed for lubricated cylinder shall not exceed 4 m/s and for non-lubricated cylinders it shall be limited to 3 m/s.
 - Distance piece of non-lubricated compressor shall of sufficient length to ensure that no oil is in contact with gland packing.
 - The design of compressor valve shall be such that the valve assembly cannot be inadvertently reversed e.g. Suction valve cannot be fitted into the discharge port.
 - Valve plates and springs shall be made of stainless steel. PEEK may be used for valve plates in case the vendor has experience of using it for similar service and duty conditions.
 - Cylinders shall be water cooled.
 - The maximum piston rod loading shall be calculated considering safety valve set pressure.
 - Non-lubricated compressors shall be provided with piston rings, packing made of carbon filled PTFE or equivalent.
 - The packing boxes shall be provided with atmospheric vents to minimize gas leakage.
 - Pulsation dampeners shall be provided for meeting the residual pulsation requirements as per API.
 - For API compressors the requirements for acoustic study shall be in accordance with the API recommendation.
 - To minimise the need for heavy overhead pipe structures, suction and discharge piping to and from the knockout drums should run close to grade, supported on sleepers.
 - Frame lubrication system shall be provided with auxiliary pump driven by electric motor for initial lubrication.
 - Cylinder lubrication, if required, shall be provided by a separate forced feed mechanical lubricator complete with necessary tubing/piping, check valve and sight flow indicator.
 - Bidder to follow the Vendor list attached with the ITB for the selection of Vendors.
 - Full flow twin oil filter shall be provided.

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3.4 Screw Compressor

The screw compressors shall conform to API-619, latest edition. If not, specifically mentioned the screw compressor may be manufacturer standard. In addition to the above, the following shall be applicable.

- 3.4.1 Each compressor together with its driver, oil system, inter-connecting piping, all auxiliary items, such as heat exchangers, separators, pumps, valves, etc., and instrumentation, shall be one integrated unit.
- 3.4.2 All drains on the process side shall have double block valves.
- 3.4.3 Manufacturer shall provide adequate relief and venting at suction and discharge.

3.5 CENTRIFUGAL PUMPS

3.5.1 Requirement

- The pumps shall be designed as per API 610, latest edition. The pumps shall be of robust design to ensure long service life and minimum maintenance requirement. The pumps shall be designed for easy access for inspection and maintenance. All continuously running pumps shall have a spare pump.
- All pumps shall have continuously rising head curve from any specified operating point to shut off point. Pumps running in parallel shall have equal head rise to shut off point.
- All pumps shall be designed for 20% overload.
- The pump shall be designed to develop the specified differential head at rated capacity, suction pressure and specific gravity while running at the rated speed. Rated speed of pump shall be full load speed of the drive motor. In case the driver is not in pump vendor's scope, full load speed of the driver shall be furnished to the pump vendor along with other details after order. The pump characteristics shall be guaranteed / tested with reference to the full load speed of motor.
- The pumps should have stable operating characteristics. The pump head at shut off shall be approximately 110% of head at rated capacity and not exceeding 120%.
- Best efficiency point shall be as close as possible to normal operating point.
- Guarantee point shall refer to the differential head, rated capacity, specific gravity, and full load speed of the driver.
- The pump and accessories shall be suitable for outdoor, unsheltered installation and continuous duty unless otherwise specified in the respective specification sheets.
- The pumps shall be supplied complete with all the accessories as specified in the respective specification sheets inclusive of necessary appurtenances, auxiliary piping, companion flanges at all terminals points, special tools, spares etc.
- Accessories required / recommended by pump vendor other than those specified in the pump specification sheet for safe and efficient operation of the pump unit shall be included in the pump vendor's scope of supply and the same shall be identified in the bid separately with adequate justification.

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- Pumps shall have SI dimensions; comply with applicable ISO standards except for piping connections which shall be as per ANSI/ASME standard.
- Reference list of pumps which are in operation for similar service conditions shall be furnished with the offer indicating broad specifications, purchase order number, date and name & address of user.
- The maximum calculated axial load shall not in any operating condition exceed 50% of bearing manufacturer's load rating.
- Metastream type of coupling shall be provided. Coupling guard shall be non-sparking for pumps located in hazardous area.
- Mechanical seal of John crane / Flowserve sanmar / Eagle-Burgmann make only shall be provided. No other manufacturer shall be acceptable. Only balanced mechanical seal shall be used.
- All continuously running pumps shall have a stand-by pump.

3.5.2 Basic Design

- It should be possible to increase the head minimum by 5% by installing higher size impeller.
- In addition to static balancing, impellers shall be dynamically balanced as per G6.3 of ISO-21940.
- Pump inlet, outlet and auxiliary connections shall be flanged. All connections shall be provided with slip-on type companion flanges, nuts, bolts and gaskets.
- Connections of 1 1/4, 2 1/2, 3 1/2, 5, 7 nominal pipe sizes shall not be used.
- When specified, pump shall be provided with drip tray under the stuffing box and leak-off line with flange, companion flange, nuts, bolts and gaskets. Material composition shall be same as that of pump casing. Leak - off piping shall be arranged upto the edge of the base plate and shall be suitably terminated by bidder to hook-up point.
- Pump inlet, outlet and auxiliary flanged connections shall conform to the facing and drilling requirements of ANSI / ASME B 16.1 or ANSI / ASME B16.5.
- All equipment shall be designed to permit rapid and economical maintenance. Major parts such as casing components and bearing housings shall be designed (shouldered or doweled) to ensure accurate alignment on reassembly.
- Impeller shall be keyed to the pump shaft. Impeller nut shall be used to secure the impeller and a positive mechanical locking method shall be adopted.
- The pump shaft shall be one piece for horizontal pumps. For vertical pumps number of shafts shall be minimum.
- Shafts for horizontal pumps shall be fitted with deflectors. Deflectors shall be made of non-sparking material (corrosion resistant material for corrosive service).
- Renewable wear ring surfaces shall be furnished on impeller and casing Mating wear surfaces of hardenable materials shall have a difference in Brinell hardness number of at least 50.

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- Radial and thrust bearings shall be rolling element type. These shall be designed for minimum 24,000 hours bearing life.
- For between bearing pumps arrangement, bearing housing shall be cast integral with the lower half of the pump casing or bolted to it. Bearing housing should be provided with stiffening brackets and be sufficiently rigid to resist the dynamic loads during operation.
- Castings shall be sound and free from shrink holes, blow holes, cracks, scale, blisters and other similar injurious defects. When weld repairs to castings are authorized by ASTM specification for the material, repair welding shall be carried out in accordance with that specification. Unless otherwise specified, weld repairs shall be inspected according to the same quality standards used to inspect the casting.
- Material of construction of pump parts shall be as per pump specification attached with process specification. If the vendor considers other materials better, same shall be offered as an alternative only. Materials not specified in the specification sheet shall be selected by the vendor in accordance with the service conditions and based on relevant codes & standards. Chemical composition and physical properties of the materials (MOC), wherever used by bidder, must be proven ones and furnished along with the offer
- A name plate of 18 Cr - 8 Ni Stainless Steel or Monel, securely attached by stainless steel pins at an easily accessible point on the pump body shall be furnished. The name plate shall be stamped with following information:
 - Purchaser's item number
 - Pump serial number
 - Capacity in m³/h
 - Differential head in meters
 - Revolution per minute
 - Casing hydrostatic test pressure in kg / cm²g
 - Absorbed power in kW
- Motor shall have power ratings including service factor at least equal to following percentage of pump rated absorbed power. :

Pump	Motor rating percentage of absorbed power
< 22	125
22 - 55	115
> 55	110

- Vendor shall indicate for vertical pumps, minimum liquid level for pump operation / startup in the offer.
- For vertical pumps, a hole shall be provided in the column pipe above the maximum liquid level to relieve pressure on stuffing box.

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- For vertical pumps, the specified head shall be measured at the discharge flange, at pump mounting level. Pumps shall be suitable to develop specified discharge head in addition to column losses and vertical distance, between minimum level in the sump tank and center line of the discharge flange. Pump vendor shall indicate total head to be developed by the pump in the offer.
- Vertical pumps taking suction from sump / vessel shall be furnished with corrosion resistant suction strainer. Perforation / mesh size shall be suitable for proper operation of pump. Sufficient free flow area of the strainer shall be provided.
- Pumps shall be provided with shaft sleeve under mechanical seal.
- Shaft sleeves shall be hard chrome oxide coated under flexible member of mechanical seal.
- Gland Packed pumps shall not be offered.
- When pumps are specified with mechanical seals: Make of mechanical seal shall be Flowserve, Eagle Burgmann, John Crane make.
- Mechanical seal shall be inside mounted, balanced type with Carbon versus Tungsten Carbide faces or Carbon versus Silicon Carbide faces. Suitable flushing plan shall be provided.
 - Coupling make shall be as follows:

Driver rating up to 25 kW	:	Lovejoy (RRL), Pinbush type Unique, Flender
Driver rating more than 25 kW	:	Pinbush type/All metallic ype Rathi-Discoflex type M, Euroflex, Triveni-Flexibox

3.6 RECIPROCATING PUMP / METERING PUMPS

- Reciprocating pump shall be designed as per API 674 latest edition and metering pump shall be designed as per API 675 latest edition.
- The metering pumps shall be suitable for continuous capacity variation from 0 to 100%. The capacity variation should be possible while the pumps are working.
- All running pumps shall have a stand-by pump.
- Pumps shall have SI dimensions and comply with applicable ISO Standards, except for piping connections which may be as per ANSI Standards.
- All threads and fasteners shall preferably be of ISO metric sizes.
- Maximum noise level shall not exceed 85 db (A) at one meter distance.
- Arrangement of equipment including piping and auxiliaries shall be developed by the vendor and submitted to the purchaser for review.
- Any water or steam jackets for liquid ends shall envelop liquid cylinders, stuffing boxes and preferably valve chambers.

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- NPSH(R) shall be indicated by the vendor taking into account acceleration head. For pumps handling volatile liquids, the NPSH required shall be determined and guaranteed after taking into account the heat generated in the glands.
- Valves and sets shall have a minimum hardness of 150 BHN if constructed of carbon or low alloy steel and 225 BHN for 13% Cr steel. The difference in hardness between valves and seats shall be 50 BHN minimum.
- Hollow plungers are prohibited. Repacking should be possible without removing plunger from the cylinder.
- Enclosed crank cases, gear units and similar mechanisms shall be sealed. Removable covers shall be provided for inspection, cleaning and minor adjustments of parts.
- For liquid end pressure containing parts like cylinders, valve chambers and suction and discharge manifolds, corrosion allowance shall not be less than 1.0 mm for carbon and low alloy steels.
- The enclosure shall be suitable for mounting on base frame and shall be weatherproof and dust tight.
- Welding of piping and pressure containing parts upto 40 kg/cm² pressure shall be spot radiographed. For pressure above 40 kg/cm² 100% radiography, magnetic particle test or dye penetrate test of welds is required.
- All pumps shall be directly coupled with their motors. V-belt shall not be used.
- Design code of offered pump to be specified in the bidders offer.
- Mechanical seal of John crane / Flowserve / Eagle-Burgmann make only shall be provided. Only balanced mechanical seal shall be used.
- For pumps with forced lubrication system, the lubrication system shall be designed as per API 614 latest edition.
- For pumps with forced lubrication system, the lubrication system shall be designed as per API 614 latest edition.

3.7 Rotary Pumps

- Rotary pump shall be designed as per API 676 latest edition.
- Pumps shall be designed and selected to ensure that suction pressure casing zones can be subjected to discharge pressure side hydrostatic test pressure.
- Installed standby pumps shall be suitable for running with equal load in parallel operation.
- All running pumps shall have a stand-by pump.
- Mechanical seal of John crane / Flowserve / Eagle-Burgmann make only shall be provided. Only balanced mechanical seal shall be used.

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- For pumps with forced lubrication system, the lubrication system shall be designed as per API 614 latest edition.
- Unless indicated otherwise multi-pole type direct drive electric motor shall be the driver for the pump to eliminate the use of gears. Electric motor drivers shall be in accordance with electrical Specification.

3.8 CENTRIFUGAL FANS / LOBE BLOWERS

- Centrifugal fans/ blower shall be designed as per AMCA standard or equivalent relevant national/ international codes, latest edition.
- Forced and induced draught fans shall be coupled to drivers through shim pack dry flexible coupling, and the complete assembly shall be mounted on a substantial bedplate.
- First critical speed of the rotor shall be higher than 120% of rated speed. Rotor assembly shall be dynamically balanced.
- Capacity control shall be achieved by means of dampers (Preferably on suction side) especially for constant speed fans, as applicable.
- The fan casing shall be suitably split such that impeller assembly can be removed for maintenance without disturbing inlet and outlet ducting.
- SS bolts and nuts shall be provided for the split casing joints of fans for corrosive service.
- The drive motors of the fans/ blower should be designed with additional capacity to take care of surge loading. However Motor rating shall be minimum 125 % of shaft power for shaft power up to 22 KW, 115 % of shaft power for shaft power between 22 – 55 KW and 110 % of shaft power for shaft power above 55 KW.
- Bearing shall be preferably oil lubricated.

3.9 HVAC System

- Centralise air conditioning system & air flow ventilation rate should be sufficient to satisfy not only air removal specification, but also to maintain over pressure and temperature specification. It should be also capable to avoid wind penetration in order to meet the requirements of a conditioned space, simultaneous control of temperature, humidity, cleanliness, contamination and air distribution should be considered in design & selection of HVAC equipment.
- Complete design of air-conditioning system (heat load calculations for all three seasons, i.e. summer, monsoon & winter with psychometric plots specifying the design TR capacity, dehumidified air quantity and monsoon/winter heating capacity).
- Environment friendly refrigerant to be used in HVAC equipment.
- All civil buildings / facility, Control room, substation, labs etc to be equipped with Centralise HVAC system (preferably water cooled) with 100 % redundancy.

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- For Stand by philosophy, it shall be noted that 1 no. Stand-by AC centralise system shall be considered for 3 nos. working units. However 2 nos stand by AC system/units shall be considered between for 4 to 6 working AC units/systems.
- One full charge of refrigerant for each air condition system to be provided as a spare.
- Site related temperature, humidity shall be considered for adequate design & selection of HVAC system along with compliance to National / international codes and standards viz. ISHRAE/ ASHRAE.
- All applicable/replaceable parts of rotating equipment such as pump blower etc shall be provided in line with design parameters specified in this document.
- All consumable along with refrigerant cylinder for each unit, V-belt for each pump/blower, filter set for each unit shall be provided.
- Adequate HVAC requirement to be covered by LSTK vendor for various building/facility of the plant including control rooms, administrative building etc.

3.10 EOT CRANES

- For Wagon tippler, Packager to provide EOT crane of 20/6T capacity however for pump and compressor house 7.5 T electric hoist shall be provided by contractor.
- Cranes to be provided in nearest multiple of 5 Metric Tonnes considering maximum weight to be lifted. Relevant Indian/ ISO Standards to be applicable for EOT Crane. All statutory guidelines to be complied by the contractor/ sub-contractor.

4.0 INSPECTION & TESTING

Machines shall be inspected by Third Party Inspection Agency (Lloyds/BV/TUV/PDIL). The Inspection and testing shall be in accordance with the all relevant codes, standards, specifications, including the minimum guide line given at Annexure-1.

- 4.1 All testing accessories, measuring instruments including NDT testing equipment, etc. shall be arranged by LSTK Contractor / Packager. DM water shall be used for hydro testing of the equipment.
- 4.2 In general, following tests shall be conducted for all rotating equipments:
- Material test
 - Non-destructive test
 - Hydrostatic test for all the pressure containing parts (1.5 times of MAWP)
 - Dynamic balancing of rotor
 - Helium leak test
 - Mechanical running test for 4 hrs
 - NPSHR test for pumps (in case difference of NPSHr & NPSHa is less than 1 m)
 - Performance Test

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- Disassembly Test
- Strip test

5.0 PAINTING

All exterior non-stainless steel surfaces subject to atmospheric corrosion with the exception of machined surfaces shall be epoxy painted. All exterior machined surfaces shall be coated with suitable rust preventives.

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ANNEXURE-1

INSPECTION & TESTING GUIDE LINES – ROTATING EQUIPMENT

1.0 SCOPE

This document covers the minimum guide lines for the Inspection & Testing for the rotating Equipments.

All rotating Equipments shall be inspected by Third Party Inspection Agency & Owner. The Inspection and testing shall be in accordance with the all relevant codes, standards, and specifications as specified in Specification sheet. Applicable codes / standards for inspection & testing to be duly followed and mentioned in ITP/QAP documents by LSTK contractor.

2.0 PUMPS AND DRIVERS

- 2.1 Pump and Compressor casings to be identified against foundry test certificates and thickness checked to conform to approved drawings.
- 2.2 Witness hydrostatic test on casings.
- 2.3 Dynamic balancing of rotor
- 2.4 Witness running tests on pumps including N.P.S.H. where applicable.
- 2.5 Non- destructive test
- 2.6 Strip inspection of pumps on completion of running tests. Wearing surfaces to be checked and recorded. As a general principle, mechanical seals will not be dismantled after running tests. This necessity will be discussed on a case to case basis if abnormal noise or temperature has need records during testing. All materials to be checked against test certificates or VENDOR'S bill of materials.
- 2.7 Final inspection and dimensional check of pump (including driver, when mounted on base plate).
- 2.8 Heat run or standard abbreviated tests, as specified, to be witnessed on electric motor drives.
- 2.9 Final inspection and dimensional check to be carried out on motor drivers.
- 2.10 Check all test certificates.

3.0 COMPRESSORS, FANS & BLOWERS AND DRIVERS

- 3.1 Material of casings or cylinders to be checked against test certificates.

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- 3.2 For fabricated casings, inspection shall be as per codes & standard mentioned in NIT.
- 3.3 Hydrostatic test on casings or cylinders to be witnessed.
- 3.4 Dynamic balancing of rotor
- 3.5 Non- destructive test
- 3.6 For fabricated impellers, welding procedure and welder's qualifications to be established and impellers to be inspected before assembly. Impellers over speed, NDT after over speed and dimensional inspection.
- 3.7 Ensure that over speed tests on impellers have been carried out and related certificate for dynamic balancing of impellers and subsequently the complete rotating assembly shall be provided. The over speed test shall be carried out to prove the impeller proper balancing and relevant certificate shall be provided.
- 3.8 Witness leakage test on lube oil tank and carry out internal and external inspection. Tank to be finally inspected after internal coating and /or painting.
- 3.9 Inspect prefabricated lube oil piping.
- 3.10 Witness performance tests shall be done and check all safety and alarm devices when contact instrumentation is fitted.
- 3.11 If spare rotating assembly is ordered, any running tests with spare fitted or the dropping of the spare into the casing, as may be specified, to be witnessed.
- 3.12 Strip inspection on completion of running tests. To include examination of all running surfaces, checking of critical clearances, and examination of lube oil filters in the tests.
- 3.13 Final inspection and dimensional check of compressors mounted on base plates.
- 3.14 Gearing, pinion forgings and main wheel forgings or castings to be inspected at forge shop or foundry.
- 3.15 Any dynamic balancing of gearing rotors to be witnessed.
- 3.16 Fabricated gear cases to be inspected at sub-supplier's works.
- 3.17 Light or full load running tests, as specified to be witnessed on gearing.
- 3.18 Final inspection and dimensional check of gearing to be done at manufacturer's works.



CLIENT : TFL, ODISHA
PROJECT: OSBL, PROJECT
LOCATION : ODISHA, INDIA

PROJ. NO. PC183-931 **UNIT:**
SPEC. NO. PC183-931-PNMC-530-
MDS-001
SHEET 1 OF 4 **REV. 0**

EQUIPMENT :
ITEM NO. :
QUANTITY :
REQUISITION NO. :
PURCHASE ORDER NO. :
MANUFACTURER :
MANUFACTURER W.O. NO. :

NOTES :

1. THIS SPECIFICATION MUST BE COMPLETELY FILLED - IN BY THE VENDOR AND SUBMITTED FOR APPROVAL.
2. IN CASE OF CONFLICT BETWEEN THIS SPECIFICATION AND THE TECHNICAL DOCUMENTS REFERRED / ENCLOSED, INFORMATION GIVEN IN THIS SPECIFICATION SHALL GOVERN.

THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION WHICH IS THE EXCLUSIVE PROPERTY OF PDIL AND IS LENT TO THE BORROWER ON THE CONDITION THAT IT SHALL NOT BE REPRODUCED, SOLD, LENT OR OTHERWISE DISPOSED OF NOR USED FOR ANY PURPOSE OTHER THAN FOR WHICH IT IS INTENDED.



CLIENT : TFL, ODISHA
PROJECT: OSBL PROJECT
LOCATION : ODISHA, INDIA

PROJ. NO PC183-931 **UNIT:**
SPEC. NO. PC183-931-PNMC-530-
MDS-001
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ELECTRIC OVERHEAD TRAVELLING CRANE - SPECIFICATION SHEET (Note-1)

GENERAL DATA

EQUIPMENT:	ITEM NO.:
REQN. NO. :	P.O. NO. :
MANUFACTURER:	MODEL :
NOS. REQD. :	INSTALLATION : <input type="checkbox"/> INDOOR <input type="checkbox"/> OUTDOOR <input checked="" type="checkbox"/> UNDER SHED
NOTE : <input checked="" type="checkbox"/> INDICATES APPLICABLE	DESIGN SPECS. : IS : 807, IS : 3177, IES : 8208

DUTY AND CONSTRUCTION CHARACTERISTICS

SERVICE :	CENTRE TO CENTRE RUNWAY RAILS - A		mm	
TYPE : <input type="checkbox"/> SINGLE GIRDER <input type="checkbox"/> DOUBLE GIRDER	MAXIMUM LIFT OF HOOK - B		mm	
SAFE WORKING LOAD : MAIN / AUXILIARY / - tonnes	MAX. HEIGHT OF HOOK ABOVE FLOOR LEVEL- C		mm	
CLASS OF CRANE :	FREE WIDTH OF STRUCTURE - D		mm	
CRANE STRUCTURE : STEEL / CONCRETE	FREE HEIGHT - E		mm	
AREA CLASSIFICATION : <input type="checkbox"/> SAFE <input type="checkbox"/> HAZARDOUS	OVERHEAD CLEARANCE - G		mm	
HAZ. AREA CLASS.:ZONE GAS GR. TEMP. CL.	TOTAL RUNWAY LENGTH :		mm	
CONTROL SYSTEM : PENDANT WITH PUSH BUTTONS	OPERATING FLOOR LEVEL :		mm	
MOTION	HOIST		TROLLEY (CROSS TRAVEL)	BRIDGE (LONG TRAVEL)
	MAIN	AUXILIARY	MAIN	
	NORMAL	CREEP		
SPEED (m/min.)			---	---
FROM FLOOR / CAB			---	---
ELECTRIC / MANUAL			ELECTRIC	ELECTRIC
RAIL SIZE			OPERATOR'S CABIN <input type="checkbox"/> FIXED TO CRANE BRIDGE	
	<input type="checkbox"/> FESTOON		<input type="checkbox"/> OPEN <input type="checkbox"/> CLOSED	
DOWN SHOP LEADS	<input type="checkbox"/> REELING DRUM		TROLLEY LEADS : <input type="checkbox"/> CABLE <input type="checkbox"/> BARE CONDUCTORS	
	<input type="checkbox"/> BARE CONDUCTORS		PENDANT LEADS : <input type="checkbox"/> CABLE	

ELECTRICAL EQUIPMENT

MOTORS	HOIST		TROLLEY (CROSS TRAVEL)		BRIDGE (LONG TRAVEL)
	MAIN	AUXILIARY	MAIN	AUXILIARY	
	NORMAL	CREEP			
TYPE			---	---	
RATING kW			---	---	
SPEED rpm			---	---	
VOLTS / PHASE / FREQ.					
LIMIT SWITCHES			---	---	

CONSTRUCTION

BRAKES

MOTORS	HOIST		TROLLEY (CROSS TRAVEL)		BRIDGE (LONG TRAVEL)
	MAIN	AUXILIARY	MAIN	AUXILIARY	
	NORMAL	CREEP			
TYPE			---	---	
NUMBER OF BRAKES			---	---	
MECHANICAL	---	---	---	---	---
E.H.THRUSTOR			---	---	

HOOKS

ROPES

	MAIN HOIST	AUXILIARY HOIST		MAIN HOIST	AUXILIARY HOIST
TYPE		---	TYPE		---
SAFE WORKING LOAD(tonnes)		---	NUMBER OF FALLS		---
ANTI RELEASE DEVICE		---	UNIT BREAKING LOAD (kN)		---
			ROPE DIAMETER (mm)		---

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CLIENT : TFL, ODISHA	PROJ. NO. PC183-931	UNIT:
PROJECT: OSBL PROJECT	PC183-931-PNMC-530-	
LOCATION : ODISHA, INDIA	SPEC. NO. MDS-001	
SHEET 3 OF 4		REV. 0

ELECTRIC OVERHEAD TRAVELLING CRANE - SPECIFICATION SHEET

WHEELS

	TROLLEY (CROSS TRAVEL)		BRIDGE (LONG TRAVEL)
	MAIN	AUXILIARY	
TYPE OF WHEELS			
DIAMETER OF WHEELS	mm	----	
NUMBER. OF WHEELS		----	
TYPE OF WHEEL BEARINGS		----	
TYPE OF LUBRICATION		----	
MAXIMUM WHEEL LOADS (WITHOUT IMPACT)	kg	----	
WHEEL BASE	mm	----	
TOTAL WIDTH OF BRIDGE CARRIAGE	mm		
TYPE OF FIXED STOP FOR BRIDGE	<input checked="" type="checkbox"/> BUFFERS <input checked="" type="checkbox"/> END STOPPERS		
TYPE OF FIXED STOP FOR TROLLEY	<input checked="" type="checkbox"/> BUFFERS <input checked="" type="checkbox"/> END STOPPERS		
TYPE OF SIGNALLING DEVICE	<input type="checkbox"/> ACOUSTIC <input type="checkbox"/> LIGHT (INDICATING LAMPS)		
TYPE OF ACCIDENT PREVENTION DEVICE	<input checked="" type="checkbox"/> GRAVITY LIMIT SWITCH		

MATERIALS OF CONSTRUCTION

MAIN HOOK	TROLLEY FRAME
AUXILIARY HOOK	ROPE DRUM
MAIN HOIST ROPE	BUFFERS
AUXILIARY HOIST ROPE	GEARS
BRIDGE GIRDER	PINIONS
<input type="checkbox"/> COPPER OR COPPER ALLOYS SHALL NOT BE USED	WHEELS

WEIGHTS

UNLADEN CRANE :	kg	UNLADEN CRAB :	kg
-----------------	----	----------------	----

TESTS AND INSPECTION

TEST	PERFORMANCE	OVERLOAD	DEFLECTION
WITNESS	<input checked="" type="checkbox"/> IN SHOP <input checked="" type="checkbox"/> AT SITE	<input checked="" type="checkbox"/> IN SHOP <input checked="" type="checkbox"/> AT SITE	<input checked="" type="checkbox"/> IN SHOP <input checked="" type="checkbox"/> AT SITE
NON - WITNESS	<input type="checkbox"/> IN SHOP <input type="checkbox"/> AT SITE	<input type="checkbox"/> IN SHOP <input type="checkbox"/> AT SITE	<input type="checkbox"/> IN SHOP <input type="checkbox"/> AT SITE

RADIOGRAPHY FOR BRIDGE GIRDER WELDS

LOAD TO BE ARRANGED BY THE PURCHASER FOR OVERLOAD TEST AT SITE

SCOPE OF SUPPLY

<input checked="" type="checkbox"/> RUNWAY RAILS	<input checked="" type="checkbox"/> RAIL FIXING BOLTS AND CLAMPS
<input checked="" type="checkbox"/> DOWN SHOP LEADS WITH GUIDES AND TROLLEYS	<input checked="" type="checkbox"/> SOLE PLATES AND CLAMPS FOR RAIL FIXING
<input checked="" type="checkbox"/> END STOPPERS FOR BRIDGE, TROLLEY & AUXILIARY HOIST	<input checked="" type="checkbox"/> TESTS IN SHOP
AUXILIARY HOIST - ELECTRICALLY OPERATED	<input checked="" type="checkbox"/> TESTS AT SITE
<input checked="" type="checkbox"/> ERECTION OF CRANE AT SITE	<input checked="" type="checkbox"/> PAINTING
<input checked="" type="checkbox"/> INSTALLATION OF RUNWAY RAILS	<input checked="" type="checkbox"/> SPARE PARTS (2 YEARS + COMMISSIONING)
	<input checked="" type="checkbox"/> DRAWINGS & DOCUMENTS IN ENGLISH LANGUAGE

Note-1: Vendor to submit the Completely filled & Signed Mechanical data sheet.

Note-2: copper & Copper alloys shall not be used in any part of machine.

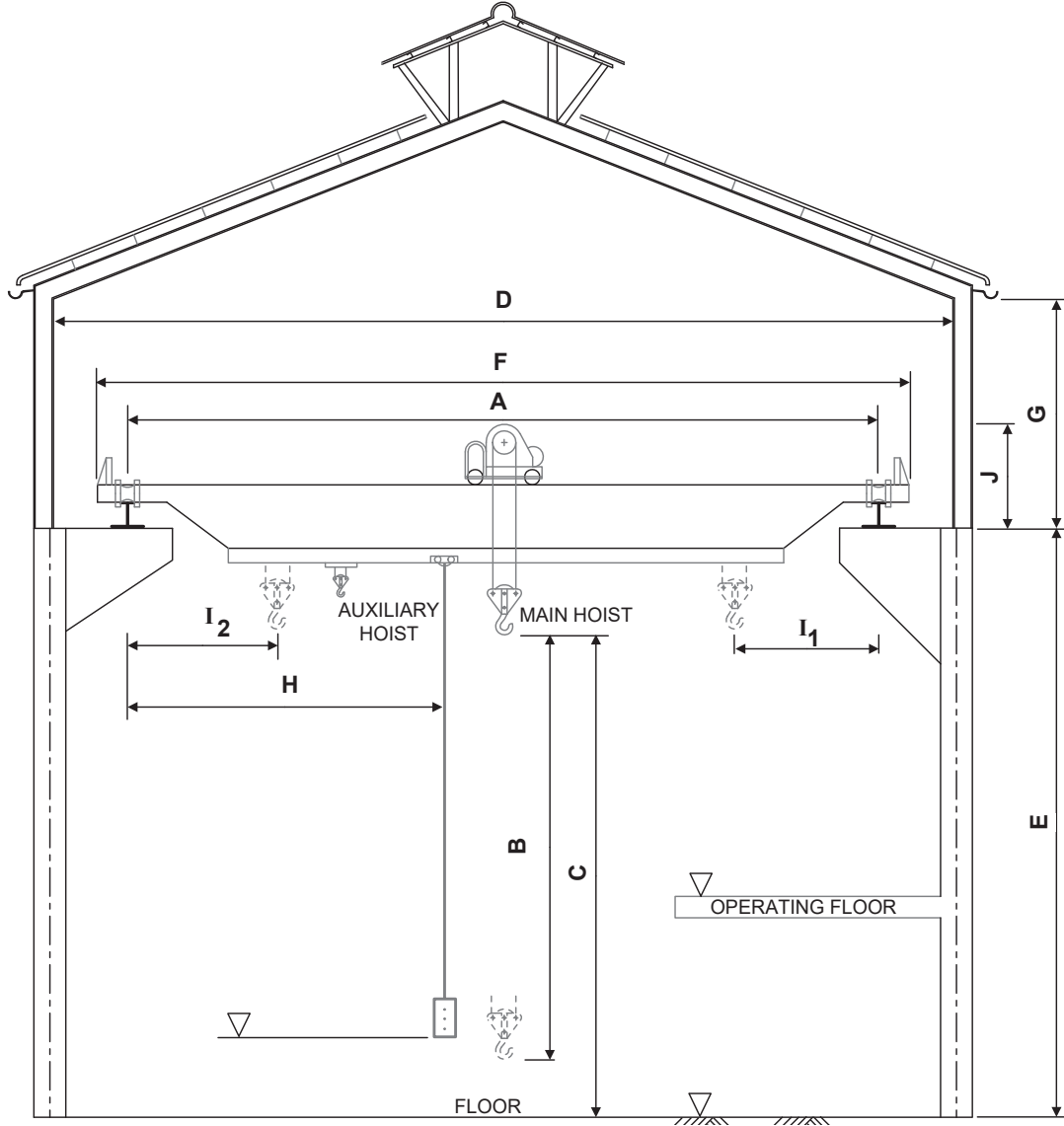
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CLIENT : TFL, ODISHA
 PROJECT: OSBL PROJECT
 LOCATION : ODISHA, INDIA

PROJ. NO PC183-931 UNIT:
 SPEC. NO. PC183-931-PNMC-530-
 MDS-001
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SKETCH & DIMENSIONS



DIMENSIONS (TO BE INDICATED BY VENDOR)

	A	B	C	D	E	F
MAIN HOIST mm						
AUXILIARY HOIST mm	----	----	----	----	----	----
	G	H	I ₁	I ₂	J	
MAIN HOIST mm						
AUXILIARY HOIST mm	----	----	----	----	----	----
	SAFE WORKING LOAD (in kg)					
MAIN HOIST						
AUXILIARY HOIST	---					

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SECTION – 3.1.3

DESIGN PHILOSOPHY-STATIC EQUIPMENT

COAL/PETCOKE/LIMESTONE HANDLING FROM RAILWAY SIDING TO STORAGE YARD

**PROJECT: INTEGRATED COAL BASED FERTILISER
COMPLEX, AT TALCHER, ANGUL DISTRICT,
ODISHA (INDIA)**



	ROM COAL/PETCOKE/LIMESTONE HANDLING FROM RAILWAY SIDING TO STORAGE YARD TALCHER FERTILIZER PLANT, ODISHA DESIGN PHILOSOPHY-STATIC EQUIPMENT	PC0183/4018/Sec VI/3.1.3	0	
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1.0	DESIGN CRITERIA
2.0	MATERIAL OF CONSTRUCTION
3.0	TECHNICAL REQUIREMENT
4.0	FABRICATION
5.0	INSPECTION & TESTING
6.0	PICKLING AND PASSIVATION
7.0	PAINTING
8.0	INSULATION
9.0	SPARE PARTS
10.0	DOCUMENTATION
11.0	VENDOR LIST

LIST OF ATTACHMENTS

SL. NO.	DESCRIPTION	DOCUMENT NO.
1.	VESSEL TOLERANCE	PDS:PV-001
2.	PROJECTION OF NOZZLES	PDS:PV-002
3.	NAME PLATE FOR VESSEL & TOWER	PDS:PV-003
4.	SKIRT SUPPORT FOR VERTICAL VESSEL	PDS:PV-301
5.	LIFTING LUG	PDS:PV-302
6.	PIPE DAVIT	PDS:PV-303
7.	DAVIT FOR MANHOLE WITH ASME FLANGE FOR HORIZONTAL VESSEL	PDS:PV-304
8.	LUG SUPPORT FOR VERTICAL VESSEL	PDS:SR-300
9.	EARTHING BOSS / CLEAT	PDS:SR-104

	ROM COAL/PETCOKE/LIMESTONE HANDLING FROM RAILWAY SIDING TO STORAGE YARD TALCHER FERTILIZER PLANT, ODISHA DESIGN PHILOSOPHY-STATIC EQUIPMENT	PC0183/4018/Sec VI/3.1.3	0	
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1.0 Design Criteria



1.1 This specification covers the requirements for the complete design (Mechanical), procurement, fabrication, construction/erection, insulation, painting, Pickling & Passivation (for SS equipments), inspection and testing of static equipment (Pressure Vessels, and Vessel Internals etc.) for ROM COAL/PETCOKE/LIMESTONE HANDLING FROM RAILWAY SIDING TO STORAGE YARD of the M/s TALCHER FERTILISER LIMITED, ODISHA in accordance with this specification, standards specification, codes and other attachment etc. listed in NIT document.

1.2 The equipment shall be designed & constructed as per the latest edition of the following codes and standards:



Code	Description
ASME Section VIII Div 1 & 2	Rules for construction of Unfired Pressure Vessels
IBR	Indian Boiler regulations
API RP 2000	Venting Atmospheric and Low pressure storage Tanks
ASME Section II A&B/ ASTM	Materials Specifications
ASME Section II PART C	Specification for welding rod, electrode & filler metal
ASME SEC II PART D	Properties
ASME Section V	Non-destructive Examination
ASME Section IX	Welding Qualification
ASME SEC X	Fiber-Reinforced Plastic Pressure Vessels
ASME B 16.5	For Flanges
ASME B 16.47	For large diameter flanges
ASME B 16.20	For Metallic Gaskets for Pipe Flanges: Ring-Joint, Spiral Wound, and Jacketed
ANSI	Pipes, Flanges, Fittings and Valves
IS: 875/SITE DATA	For wind load consideration
IS: 1893 (Part 4) & IS: 1893 (Part 1) / SITE DATA	For seismic design consideration

1.3 Complete mechanical design of Equipment as per latest code /standard of construction shall be the responsibility of the LSTK Contractor. Strict compliance with the requirement of codes/equipment specification & any other referred document shall be ensured. In addition, all statutory rules & regulations shall also be complied with.

1.4 Design conditions for all equipment shall be as per technical Specification and Material specification. Minimum required thickness is calculated based on design parameters considering different types of loadings including effect of static head of liquid column. Equipment shall also be designed for hydrostatic condition. Final thickness is decided giving due consideration for corrosion allowance.

	ROM COAL/PETCOKE/LIMESTONE HANDLING FROM RAILWAY SIDING TO STORAGE YARD TALCHER FERTILIZER PLANT, ODISHA DESIGN PHILOSOPHY-STATIC EQUIPMENT	PC0183/4018/Sec VI/3.1.3	0	
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- 1.5 Design pressure shall be at the top of vertical vessel or at the highest point of horizontal vessel. The design pressure at any lower point shall be determined by adding the maximum operating liquid head and any pressure gradient within the vessel.
- 1.6 Wind analysis shall be performed as per IS-875 (Latest Edition). Wind forces shall be increased by 20% (over & above design code requirement) to cater the effect of piping system, platforms and ladders etc.
- 1.7 Seismic analysis shall be performed by Response spectrum method (RSM) considering seismic zone-IV as per IS-1893 part-1 & IS-1893 Part 4 (Latest edition). Consider Importance factor as 1.5 and force factor 2 in equipment seismic design.
- 1.8 All carbon steel (CS) & low alloy steel (LAS) pressure parts shall have 3 mm corrosion allowance.
- 1.9 All internals CS/ LAS parts including low temperature materials shall have at least 1.5 mm corrosion allowance on either side unless otherwise specified.
- 1.10 Design of supports and anchor bolts shall be performed for compressive and tensile loading. In no case shall diameter of anchor bolts be less than M24 for skirt support and M16 for other type of support.
- 1.11 Each Lifting lug shall be designed with shock factor 2.
- 1.12 Hydro testing of equipment shall be as per UG-99b of ASME Sec VIII Div-1. In order to safeguard against the risk of brittle fracture during hydrostatic test metal temperature during hydrostatic test be maintained at least 30°F (17°C) above the minimum design metal temperature, but need not exceed 120°F (48°C). Design pressure for each nozzle shall be sum of maximum allowable working pressure and static head of corresponding nozzles.
 - 1.12.1 Maximum Allowable Working Pressure (MAWP) is the maximum gauge pressure at the top of a completed vessel, which is obtained from the calculations for every element of the vessel based on the actual thickness in the corroded condition. Supplier shall calculate the MAWP of each vessel, and the calculation shall be included in design calculations. MAWP shall not be assumed to be the same as the design pressure except for cases where MAWP cannot be determined by calculation to the applicable code. Accordingly calculate hydro test pressure as per UG-99b.
- 1.13 Bolt of size M 48 and above shall be designed and spaced so as to permit tightening with a hydraulic stud-tensioner. The bolts shall have an extra threaded length at one end of approximately 1 bolt diameter, and shall be provided with threaded protection caps. Hex nuts shall have suitable holes for manual tightening. The requisite no. of hydraulic stud-tensioner device with necessary adapters/insertions based on varying sizes of studs shall be supplied by Bidder as per mechanical design of the equipment.
- 1.14 Orientation of longitudinal seams and position of circumferential seams shall be clearly marked in the fabrication drawing. Nozzles, support and other attachments shall be located clear of welded joints.
- 1.15 All process equipments shall be supplied with Nitrogen filled. In case of equipment assembled and welded at site, it shall be filled with N₂ after testing at site. Dry Nitrogen shall be filled at a pressure of 0.5 Kg/cm²g and equipment shall be fitted with a pressure gauge and valve.



	ROM COAL/PETCOKE/LIMESTONE HANDLING FROM RAILWAY SIDING TO STORAGE YARD TALCHER FERTILIZER PLANT, ODISHA DESIGN PHILOSOPHY-STATIC EQUIPMENT	PC0183/4018/Sec VI/3.1.3	0	
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- 1.16 Bidder shall guarantee the equipment & their components against faulty design with regard to their mechanical adequacy, improper material of construction & poor workmanship for the period specified in contract.
- 1.17 NITder shall stand Performance Guarantee of equipment as per respective technical specifications/Process Data sheets.
- 1.18 Design conditions for all equipment shall be in accordance with the process data Sheets/specification .However, in any case design pressure shall not be lower than 10% over the maximum anticipated operating pressure and design temperature should be 25°C higher than the maximum anticipated operating temperature for all equipment unless otherwise specified.
- 1.19 Basic allowable stresses for shell, heads and other components etc. of vessels and shell, roof, etc. of tanks shall be the values specified in the design code.
Maximum allowable “tensile stress” and “compressive stress” shall be as per UG-23 of ASME Sec VIII Div -1. These stresses may be increased by 20% for earthquake & wind combination case in line with UG-23 (d).
- 1.20 All blind flanges and man way covers weighing 35 kgs or more shall be fitted with handling Facilities such as davits.
- 1.21 As a General rule all nozzle attachment to shell/head shall be set in type.
- 1.22 In case of conflict between this specification and other specification, codes and data sheets. It shall be referred to PDIL/ Owner for clarification and the decision of PDIL/Owner shall be final & binding on contractor without any cost & delivery implications. However, it shall be resolved considering the most stringent in the following order
- Statutory requirement
 - Requirement specified in this specification
 - Process data sheet/ P&ID
 - Applicable codes & standards
- 1.23 Unless otherwise specified, SI unit shall be applied as the measurement system for the drawing and documents to be submitted.
- 1.24 When post weld heat treatment is required for pressure vessels, all material for pressure holding Components shall be simulation tested with minimum additional two (2) heat treatment cycles. Additional two heat treatments are; one for PWHT after shop repairing and the other for future PWHT at site

1.23 REGULATIONS

Besides codes & standards, LSTK Contractor shall follow National Laws and Regulations such as Indian Boiler Regulation and Department of Explosives, Nagpur, India together with Local by Laws for the state including statutory requirements as applicable. Static and Mobile Pressure Vessel (SMPV) rules as applicable shall also be complied with.

PUBLICATIONS:

	ROM COAL/PETCOKE/LIMESTONE HANDLING FROM RAILWAY SIDING TO STORAGE YARD TALCHER FERTILIZER PLANT, ODISHA DESIGN PHILOSOPHY-STATIC EQUIPMENT	PC0183/4018/Sec VI/3.1.3	0	
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- WRC Bulletin # 107 Local Stresses in Spherical & Cylindrical Shells due to External Loadings.
- WRC Bulletin # 297 Local Stresses in Cylindrical Shells due to External Loadings on Nozzles

1.24 DESIGN DOCUMENTATION

1.24.1 Detailed design calculations considering different loadings shall be made as per code/standards and the additional requirements as mentioned below:-

1.24.2 Design of equipment inside the offsite plant complex shall be in accordance with the process licensor's data sheets and specifications.

1.24.3 LSTK Contractor shall consider the interfaces with other engineering disciplines w.r.t.

- Piping Layout/Location Drawings
- Civil / Structural Drawings
- P & ID's
- Materials
- 3D PDS Model for Piping and Equipment Layout
- Hazardous Area Classification

1.24.4 Design philosophy of other disciplines shall be observed and shall be relevant to the extent applicable.



- Civil/Structural Design Criteria
- Piping Design Criteria
- Process Design Criteria
- Electrical and Instrumentation Design Criteria

1.25.1 CONSTRUCTION & ERECTION

LSTK Contractor shall follow standard established procedures for handling storage, construction & erection. LSTK Contractor shall strictly follow Manufacturer's/Principal's instructions, approved drawings and procedures for construction & erection and satisfy Principal in all respects of storage, handling, construction & erection of Package. All erection work shall conform to the working/erection drawings (to be prepared by LSTK Contractor) and shall be in conformity with codes & standards as applicable. The LSTK Contractor shall supply & arrange all necessary construction & erection tools and tackles, machinery, scaffolding etc.

1.25.2 LSTK Contractor shall perform the following:

- i) Before installing the equipment, the foundations shall be checked and wherever Necessary, chipping shall be done by the LSTK Contractor. All grouting materials, packing plates/wedges required for the levelling and alignment of equipment, structures & pipelines etc shall be provided.
- ii) Top of the foundations shall be thoroughly cleaned to the satisfaction of Principal / LSTK Contractor before placing base plates.

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- iii) All equipment & structure etc. shall be checked and inspected for its proper levelling and granting (grouting) shall be done with suitable grouting material as required.
- iv) After tightening the foundation bolts, the final level / alignment shall be rechecked and redone, if required.
- v) Installation of all supports and hangers, including concreting or welding as necessary.
- vi) To check correctness of the piping, instruments and other connecting points in the equipment and piping installed.
- vii) The welding joints shall be stress relieved wherever necessary as per applicable codes, Standards & specification.

1.25.3 The following shall be arranged and supplied by LSTK Contractor for completion of job. Any other item whatsoever required shall also be included by LSTK Contractor in their scope.

- i) All construction & erection materials, equipment & machinery, scaffolding, consumable, and test equipment etc.
- ii) Cranes/Hydra, temporary lifting beams and spreaders etc.
- iii) Procedures for site assembly, construction & erection including lifting methodology for Owner/Third party approval.



1.25.4 As a minimum contractor shall comply the requirements indicated below:

- i) Fabricate, erect and align the equipment & internals as per applicable codes, standards & specifications. All internals shall be inspected before and after installation.
- ii) Carry out all NDT's required. The Personnel performing NDT's should have a minimum qualification as "NDT LEVEL-II" in the relevant Technique, certified by American Society for Non-destructive Testing.
- iii) Perform non-operating field pressure tests and leak tests on field fabricated equipment in accordance with the applicable codes, standards and specifications, ensuring disposal of test media in accordance with instruction/recommendations
- iv) Notify Owner / Third party of the test schedules for witness the tests by concerned inspector.

1.26 QUALITY ASSURANCE & CONTROL

1.26.1 The quality assurance shall be as per the approved procedures, test methods & facilities to be developed by the LSTK Contractor to ensure that the supplied equipment shall be of highest quality. The quality control shall mean that all the tests, measurements, checks & calibration which are to be carried out may be compared with the actual specified characteristics of the equipments/unit /system.

1.26.2 Quality Assurance (QA) shall mean the organizational set up, procedures as well as test methods and facilities developed by LSTK Contractor in order to assure that Equipment leaving LSTK Contractor's shop are of the highest possible quality i.e. either equal to or better than the requirement specified.

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1.26.3 Quality Control (QC), shall mean all the tests, measurement, checks and calibration which are to be carried out in LSTK Contractor's shop in order to compare the actual characteristics of the equipment/unit/system with the specified ones, along with furnishing of the relevant documentation (certificates/records) containing the data or result of these activities.

1.26.4 LSTK Contractor shall submit a comprehensive description (manual) of QA/QC measures contemplated by him for implementation with regard to this specification. It is contractual obligation of the LSTK Contractor to develop and implement adequate QA/QC systems. QA/QC system shall cover all products and services required for the equipment as per scope of work including job sub contracted by the LSTK Contractor.

2.0 Material of Construction

2.1 Material of construction for various equipment shall be as selected as follows for general Condition/service unless specified otherwise in respective process data sheet.

a) Pressure Vessel (KCS/CS)

Shell /Head plates	: SA 516 Gr. 60/70 (Epoxy /rubber Line as applicable)
Nozzle Flange	: SA 105 (Epoxy /rubber Line as applicable)
Nozzle Neck (Pipe/Plate)	: SA 106 Gr. B (Nozzle size < 10"); SA 516 Gr. 60/70 ((Epoxy /rubber Lined as applicable) (Nozzle size > 10"))
Non standard forging	SA 266 Gr 2 (Epoxy /rubber Line as applicable)

b) Pressure Vessel (SS)

Shell /Head plates	: SA240 Gr*
Nozzle Flange	: SA 182 Gr*
Nozzle Neck (Pipe/Plate)	: SA 312 Gr* (Nozzle size < 10"); SA 240 Gr * (Nozzle size > 10")
*SS grade as specified in datasheet	

2.2 The Additional material requirements as indicated below shall be considered by NITder.



2.2.1 All raw materials including bought -out items, whatsoever required, to complete the supplies shall be procured and supplied with due identifiable mill material test certificates & inspection reports duly certified by third party inspection agency

2.2.2 For coarse grained and high tensile materials in carbon steel (UTS > 45 Kg/mm²) and low alloy steel, guaranteed impact strength shall be ensured at a temperature 15 degree C below envisaged hydraulic test temperature as a precaution against brittle fracture during hydraulic test.



2.2.3 Carbon steel plates shall be procured in fully killed condition. CS plates shall be fully killed & normalized. All plates above 50mm thickness shall be vacuum-degassed and examined by Ultrasonic Testing (UT) as per applicable material specification code/standard.

2.2.4 All Stainless Steel (SS) plates shall be hot rolled & solution annealed and pickled as per SA-480.

2.2.5 All forgings except for flanges as per ANSI shall be UT tested as per ASTM A 388 for the thickness greater than 50mm and shall be procured in normalized / annealed condition acceptance standards shall be as per AM 203.2 of ASME Section VIII Div. 2. In case any defect is found, no repair by welding shall be allowed.

	ROM COAL/PETCOKE/LIMESTONE HANDLING FROM RAILWAY SIDING TO STORAGE YARD TALCHER FERTILIZER PLANT, ODISHA DESIGN PHILOSOPHY-STATIC EQUIPMENT	PC0183/4018/Sec VI/3.1.3	0	
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- 2.2.6 All forgings including nozzle flanges shall be examined for surface defects by MP/PT testing after matching as per applicable material specification code & standard.
- 2.2.7 All external / internal attachments, pads/cleats for support directly welded to the equipment shall be of same materials as that of equipment, unless specified otherwise.
- 2.2.8 All nozzles up to DN 10" size shall be made of seamless pipe. For sizes above DN 10" nozzle connection shall be rolled from plates with full radiography of plates.
- 2.2.9 Unless otherwise specified girth flanges shall be of forged quality and ultrasonically tested.
- 2.2.10 Unless more restrictive prescription given by material specification the max. Content for carbon steel used for fabrication as shown by ladle analysis shall be 0.23% for plates, pipes & tubes 0.25% for forging.
- 2.2.11 Top portion of skirt (min. 500 mm height) welded to the bottom dished head shall be of same material as that of shell /head for LAS & SS materials.
- 2.2.12 Heat treatment of formed parts shall be carried out as per following:
- For Carbon Steel:**
- Cold formed dished ends or knuckles up to 16 mm nominal thickness shall be stress relieved.
 - Cold formed dished ends or knuckles above 16 mm nominal thickness shall be normalised.
 - For Low alloy Steel: - Cold Formed Dish ends or Knuckles shall be stress relieved.
 - Hot formed dished ends or similar parts, which have not been uniformly heated in the normalising range in the final stages of manufacture shall be normalised.
 - When the completed vessel involves post weld heat treatment, heat treatment recommended in (a) above shall not be applicable.
 - Vessels in caustic service, Amine or Sour gas service shall be stress relieved.
 - All internal and external attachments, clips, insulation studs, name plate bracket, and the like Shall be welded to the vessel before post weld heat treatment.
- 2.2.13 PWHT of complete vessel shall be carried out in one go in a furnace. Local stress relieving of Weld joint in piece meal shall be avoided as far as possible.
- 2.2.14 All Nozzle Flanges & Gaskets size, rating & type etc. shall be as per applicable piping Specifications & instrument specification as applicable enclosed with the enquiry and Selected bolting shall match with corresponding companion flanges.
- 2.2.16 Equipment under Caustic service shall essentially be PWHT with 100 % radiography. The hardness of the parent weld, weld & HAZ shall be Limited to 200 BHN.

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2.2.17 Unless otherwise specified Copper & Copper alloys shall not be used. Copper content up to 0.4% are acceptable in carbon steel & 0.6% in stainless steel.

3.1 Vessel

3.1.1 Design, materials, fabrication and inspection of welded pressure vessels shall comply with ASME Code Section VIII, Division 1 (latest edition) and design philosophy.

3.1.2 For vessels the minimum thickness of shell & heads, including corrosion allowance shall be as indicated below:

Sr. No	Shell Diameter(mm)	Thickness (Min.) mm	
		CS / LAS	HAS
1.	ID < 500	5	3
2.	501 < ID < 1200	5	4
3.	1201 < ID < 2000	6	5
4.	2001 < ID < 2600	8	6
5.	ID > 2600	10	8

CS = Carbon Steel, LAS = Low-Alloy Steel, HAS = High-Alloy Steel

3.1.3. All nozzles above 24" NB shall comply with ASME B16.47 Series B (API 605).

3.1.4. Minimum branch nozzle thicknesses shall be Schedule Extra Strong above 2" NPS, and Schedule 160 for 2" NPS and below.



3.1.5 Stress calculations due to Local loads on vessel for external structural attachments, such as platform clips, pipe support clips and lifting lugs shall be performed.

3.1.6 Design of vessel skirt shall be based on seismic/wind/thermal considerations and fire proofing/insulation requirements.

3.1.7 Vessel skirts for carbon steel vessels shall be designed from the same material as the shell or the head. Vessel skirts for other than carbon steel vessels shall be the same material as the shell or the head for the top 500 mm.

3.1.8 Vessels with skirt support having eight or more anchor bolts shall be required to be supplied with an anchor bolt template. The template shall be an annulus 10 mm (minimum) thickness and 150 mm (minimum) wide, with bolt holes equal to bolt diameter plus 3 mm, stacked drilled with skirt base plate.

3.1.9 Maximum permissible deflection for columns when subjected to design wind loadings shall not exceed 0.005 x Vessel height.

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3.1.10 Minimum man way size shall be equal to 24” nominal pipe size.

3.1.11 Manhole/hand hole/blind holes covers shall be equipped with davits or hinges to facilitate handling.

3.1.12 Horizontal vessels of large size and thin wall shell on saddle supports shall be investigated for buckling, local circumferential bending and shear stress. The method of L. P. Zick (Supplement to Welding Research, 1971) may be used for this investigation.

3.1.13 Use of structural steel shall be limited to non-pressure parts only.

3.1.14 Local vessel stress calculations for external structural attachments, such as platform clips, pipe support clips and lifting lugs shall be performed.

3.1.15 Dimensional tolerances shall be in accordance with the design codes or standards, whichever is more stringent.

3.1.16 For vessel with diameter less than 900 mm and having removal internals, shell flange shall be provided.

3.2 Safety

3.2.1 Safety standards and features which are inherent in the specific mechanical equipment design codes, standards and regulations are applicable.

3.2.2 Safety features to be incorporated into the design include, but are not limited to, the following features for equipment:

- i) Ladder cages
- ii) Safety chain across platform access
- iii) Step-off platforms where necessary
- iv) Platform grating
- v) Toe plates



4.0 Fabrication

4.1 The Bidder shall comply in all respects with the provision of the applicable codes, standards and specification during fabrication with respect to tolerances, welding, fabrication, forming of heads, radiography, heat treatment, inspection, testing and quality control etc. unless & otherwise specified.



4.2 Plates of different thicknesses shall be made flush with the inner surfaces of equipment unless otherwise stated.

4.3 Larger heads which cannot be formed in one piece shall be fabricated as follows with prior approval from Principle.

- a) In two pieces, with the welding seam included in the middle third and preferably on the centre line
- b) In petal construction, with meridional seams and a central cap of diameter not larger than 0.75 times the vessel outside diameter

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- 4.4 Due provisions must be kept for venting out entrapped gases during welding of pads, flanges and liner plates etc.
- 4.5 All welding shall be carried out by qualified welders using approved procedures in compliance with the requirements of codes, standards & specifications and shall be duly certified by the concerned inspecting authority. All welding procedures must be got approved from authorised inspecting authority before starting any fabrication job. Welding of all parts must be completed before heat treatment.
- 4.6 All welds shall be full penetration welds with back chipping and re-welding from the second side. For those joints which are inaccessible for back chipping the root run shall be carried out with TIG process. Single side welding with backing strips shall are not permitted.
- 4.7 All parts shall be fabricated in accordance with good shop practice and in uniformity so that all corresponding parts will be inter-changeable.
- 4.8 All sharp corners shall be rounded off with smooth radius. Inside edge of manhole and hand hole at the internal surface shall be rounded to minimum radius 5 mm.
- 4.9 All flange bolts & skirt-bolts shall straddle centre line unless otherwise stated.
- 4.10 In case of nozzle with butt-end construction, extra length shall be provided to facilitate hydraulic testing and subsequently cutting and edge preparation to suit piping welding at site.
- 4.11 All nozzles less than or equal to NB 65 mm shall be stiffened with three equispaced plate ribs of the same material as that of shell.
- 4.12 Flange facing and thread connection shall be protected against oxidation during HT.
- 4.13 Longitudinal and circumferential welded seams shall not interfere with nozzle openings, reinforcement plates, saddle pads, and other attachments as far as possible.
- 4.14 Welding wherever specified, is to be done by qualified and approved welders using the suitable fillers and fluxes recommended for the materials in the fabrication drawings.
- 5.0 Inspection & Testing**
- 5.1 Equipment shall be inspected and tested in accordance with the relevant codes, standards and specifications by owner approved TPIA. All equipment shall be inspected during various stages of manufacturing starting from identification of raw materials to final completion as per agreed Quality Assurance Plan (QAP) which shall be prepared by Successful Bidder after award of contract. In case of site fabricated/assembled equipment same inspection agency shall be responsible for inspection and testing at site. However all the bought-out items must be supplied with test certificate and inspection reports.
- 5.2.2 The equipment shall be inspected by Third party inspection agency (TPIA) as defined elsewhere as inspection agency. It shall be the responsibility of the Bidder to make available to the inspector all the drawings, calculations and other documents. However the Principal shall have free access for inspection at vendor's/sub-vendor's shop and at site during project execution.

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- 5.2.3 The equipment shall be considered acceptable for despatch only after final certification for acceptance is issued by concerned inspector.
- 5.2.4 All parent material (Primary & Secondary Components), welds and HAZ shall be impact tested at Minimum Design Metal Temperature (i.e. minimum service temperature or the temperature to be computed as per applicable codes, standards & specifications) by Bidder and shall have impact energy values as per the applicable codes, standards & specifications.
- 5.2.5 Production control coupons, when required as per codes & standards shall be subjected to impact test, corrosion test etc. in addition to mechanical tests as required. In case of heat treated equipment test coupons shall be given similar heat treatment as for the equipment.
- 5.2.6 Formed heads when fabricated in pieces shall be normalised and weld seams fully radiographed after forming.
- 5.2.7 Vessel containing lethal, toxic and highly inflammable substance shall be fully radiographed and stress relieved.
- 5.2.8 All nozzle reinforcing pads shall be tested pneumatically at 0.5 Kg/cm²g pressure with soap solution on attachment welds. Vent holes shall be plugged with non hardening mastic to prevent ingress of water
- 5.2.9 . All completed equipment shall be tested hydraulically as per the requirements of codes, standards & specifications in presence of the inspecting authority. Pneumatic test of completed equipment shall be carried out only when specially mentioned in the specification sheets. Chloride content in water used for testing shall not exceed 30 ppm for SS equipment and 40 ppm for CS and low alloy steel equipment. Duration of test shall be as per applicable codes & standards
- 5.2.10 . The temperature of test water shall comply with requirement of Fabrication code.
- 5.2.11 Unless otherwise stated gaskets used during testing shall be same as specified for operating conditions. However all joint gaskets shall be replaced by new gasket which will be opened after Hydro testing.
- 5.3 The following NDT requirements are mandatory in addition to codes, standards & specification requirements:

A) UT examination

- i) All butt - welds in thickness greater than 50mm as supplement to radiograph
- ii) FPW of nozzle attachments of thickness above 50mm as supplement to radiography
- iii) Clad Plates and formed heads from clad plates in all thicknesses
- iv) All forgings

B) MP / PT examination

- i) All edges of plates and opening in shell of CS having thickness equal to & above 40mm and LAS / SS having thickness more than 25mm
- ii) Root and final layer of all butt welds
- iii) Fillet welds of SS

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- iv) All weld surfaces after PWHT
- v) Each layer of weld deposit in SS overlay
- vi) Knuckle surfaces of dished ends, expansion bellows and pipe bends
- vii) All forgings after machining
- viii) Skirt to head joint
- ix) Each pass of tube to tube sheet joint
- x) Bent portion of all U-tubes

C) Radiography:

- i) All weld seams of formed head, if made in more than one segment shall be full radiographed after forming
- ii) When spot radiography is specified, all T – Joints & minimum 5% of total weld length excluding T joints shall be radiographed
- iii) All nozzles fabricated from plates shall be 100% radiographed
- iv) Radiography of welds in C - 1/2 Mo & Cr - Mo - Steel preferably be carried out after

Note : If a vessel is not 100% radiographed and/or UT tested, then a minimum examination of butt, corner & T-joints shall be made.

6.0 Pickling and Passivation

6.1 All SS material shall be Pickled & Passivated as per following procedures:

6.1.1 Pickling

Aqueous pickling solution shall be as follows:

Nitric acid (Tech. grade) 10 to 25% plus Hydrofluoric acid 1 to 8% (to be used only for stabilised SS grades). Temperature 50 to 60° C for 10% Nitric acid and 20° C for 25% Nitric acid. When size and shape of product permit, total immersion in the pickling solution is preferred. Where immersion is impractical, pickling may be accomplished by wetting the surface by



- i) Swabbing or spraying
- ii) Partial filling the item with pickling solution and rotating or rocking so that all the surface receives the required chemical treatment.

The maximum period for which the pickling solution shall be allowed to remain on the surface is 30 minute. During pickling removal of oxides may be hastened by brushing with a hard fibre or SS wire brush. Over pickling shall be avoided.

The pickling agent shall be washed off with plenty of water so as to leave no trace behind.

6.1.2 Passivation

After pickling and water rinsing, an aqueous caustic permanganate solution containing NaOH 10 weight % and KMnO₄ 4 weight % shall be used for neutralising pickling solution. This shall be followed by thorough water rinsing.

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Water used for pickling and washing shall not have chloride contents exceeding 30 ppm.

7.0 Painting

7.1 All CS external surfaces of shop fabricated equipment shall be primer and final painted as per section -4 of NIT document.

8.0 Insulation

8.1 The equipment shall be insulated as defined elsewhere Listed in NIT document.

9.0 Spares (Erection & commissioning, Mandatory Spare etc.)

9.1 COMMISSIONING SPARES

9.1.1 All commissioning spares shall be included by LSTK Contractor in their scope of supply and shall be part of the main equipment.

9.2 Mandatory Spare

9.2.1 Mandatory Spare shall be supplied by the contractor as per Section-6 of NIT.

10.0 Documentation

Documents shall be submitted as per "Documentation schedule" in Section-5 of NIT.

11.0 Vendor List

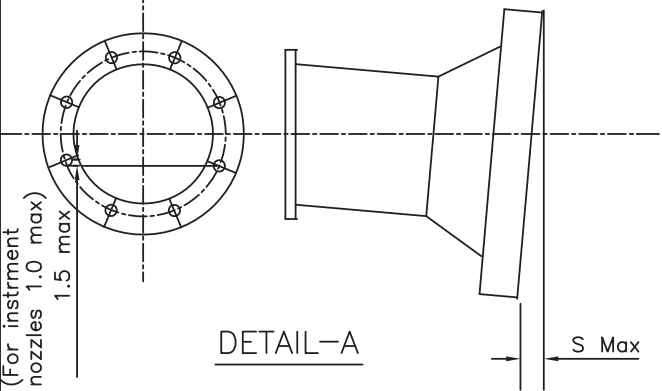
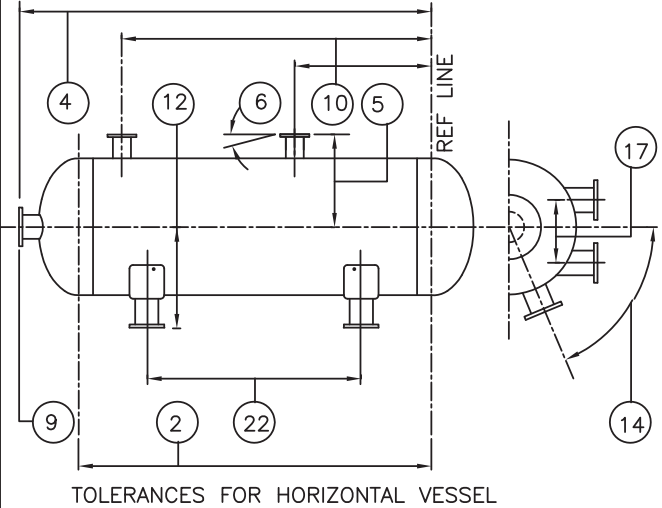
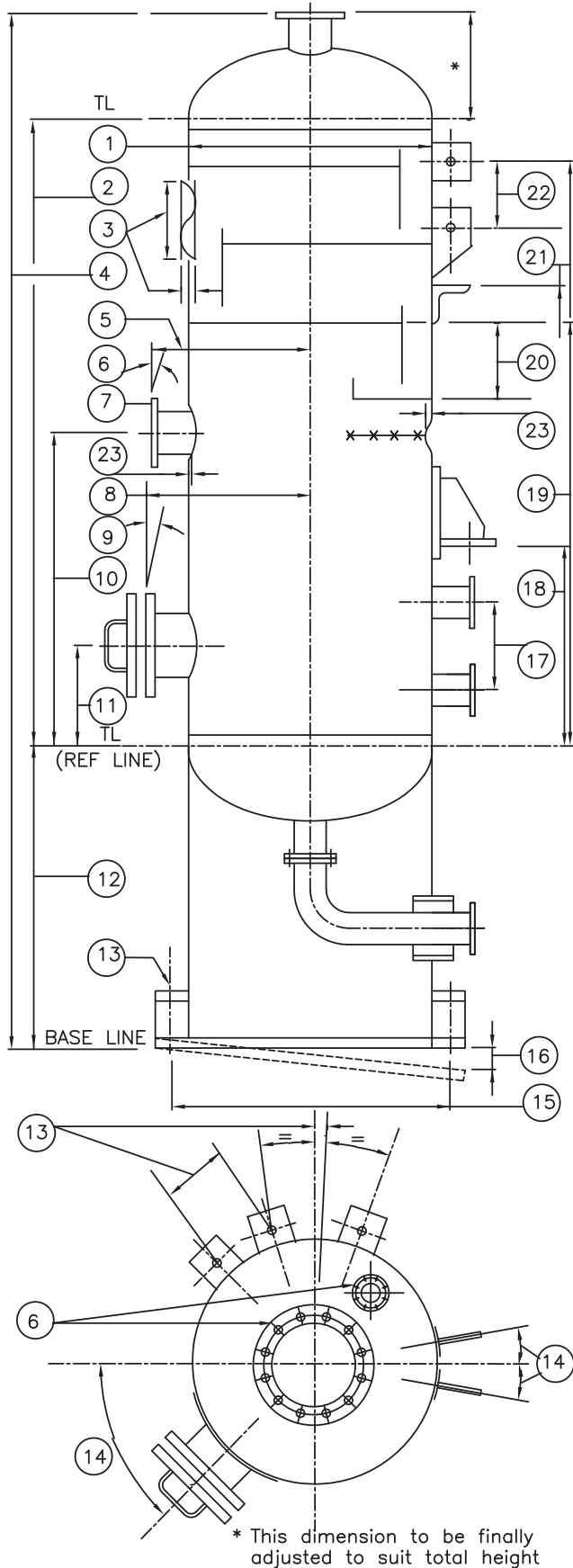
All equipment shall be procured/ fabricated as per approved vendor list (Section-10). Any equipment for which vendor list is not enclosed, the LSTK Contractor may furnish a list of their proposed vendors along with their references for supply of similar type of equipment along with NIT. However all the additional proposed vendors shall have well proven track record and shall be subjected to consultant/owner's approval

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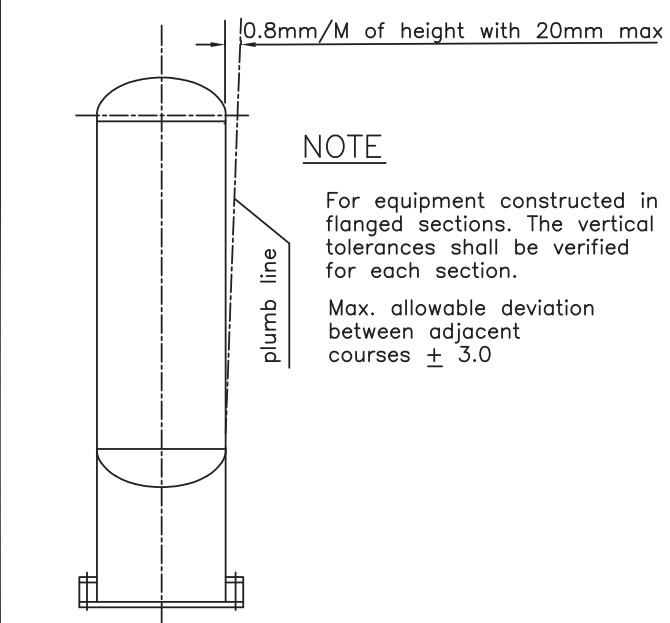
VESSEL TOLERANCES

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Nozzle size	S Max.
NPS ≤ 4 INCH	1.5
6 INCH ≤ NPS ≤ 12 INCH	2.5
NPS > 12 INCH.	5.0

S max shall be ± 0.5mm for instrment nozzle



NOTE
 For equipment constructed in flanged sections. The vertical tolerances shall be verified for each section.
 Max. allowable deviation between adjacent courses ± 3.0

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VESSEL TOLERANCES

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1) Shell Tolerances

Nom. vessel Diameter	Tolerance
600 & under	± 2.5
Over 600 to 1200	± 4.0
Over 1200 to 2100	± 6.0
Over 2100 to 2700	± 7.0
Over 2700	± 8.0

- 2) Distance between top & bottom tangent lines, ±1.5 mm/M height, max. ±12
- 3) Linearity of cylindrical surface, ± 3mm/6M, max. of 20
- 4) Height from base line to face of top nozzle, ± 5 max.
- 5) Face of nozzle from centre line of vessel, ± 3
- 6) Alignment of flange face of nozzle shall be as given in Table (Under Detail 'A')
- 7) Rotation of flange holes with reference to nozzle axis; 1.5 max.
(Refer Detail 'A')
In case of instrument connections this shall be 1.0 mm max.
- 8) Face of manhole from centre line of vessel, ± 6
- 9) Alignment of flange face of manhole shall be ± 6 in both vertical and transverse planes.
- 10) Location of shell nozzle from reference line, ± 3
- 11) Location of manhole from reference line, ± 12
- 12) Bottom of skirt base ring to the bottom tangent line of vessel, $\begin{matrix} +0 \\ -6 \end{matrix}$
- 13) Orientation of anchor bolts with respect to principal axes, ± 6
- 14) Tolerance in orientation of nozzles and external clips, ± 3
- 15) Distances of bolt holes from axis up to 2000 dia ±3 & over 2000 dia ± 6

Nom. Vessel Diameter	Tolerance
1200 & under	±3
Over 1200 to 2000	±5
Over 2000	±7

- 16) Maximum deviation of skirt base
- 17) Distance between level control nozzles, ± 1.0 mm
- 18) Distance between support bracket and reference line, $\begin{matrix} + 6 \\ - 0 \end{matrix}$
- 19) Location of tray support ring from reference line, ± 6
- 20) Tolerance between adjacent tray plates, ± 3
- 21) Location of external clips and attachments from reference line, ± 6
- 22) Distance between adjacent clips for platform brackets, ± 3
- 23) Irregularities in profile (checked by a 20° gauge) shall not exceed
 $\delta \leq 0.05 \cdot e + 0.002 \cdot D$ (Maximum 25 mm)
 Where δ = Maximum local irregularities
 e = Plate thickness
 D = Shell outside diameter

Notes :

- 1) In case of difference between the values tabulated here and those shown in the drawings, the latter shall govern.
- 2) For fabrication & assembly tolerances on vessel internals, see ES : 3105
- 3) For vessels fabricated from pipe— diameter and out of roundness tolerance to be in accordance with relevant pipe specification.
- 4) All dimensions are in mm unless otherwise specified.

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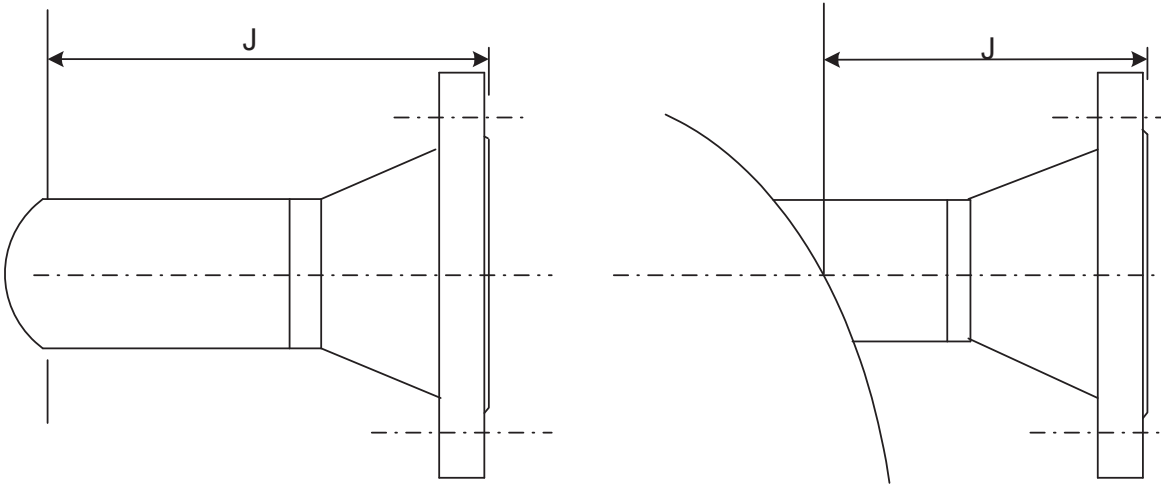
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PROJECTION OF NOZZLES

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VALUES OF 'J'

Nozzle Diameter NPS	Rating 150#	Rating 300#	Rating 600#	Rating 900#	Rating 1500#	Rating 2500#	Remarks
≤ 3"	200		200		200	350	
4"	200		250		250	350	
6"	200	250	250		250	350	
8"	250		300		350	550	
10"	250		300		350	550	
12"	250		300	350	350	550	
14"	250		300	350	450	--	
16"	300	350	350		450	--	
18"	300	350	350		450	--	Refer Note-4
20"	300	350	350		500	--	Refer Note-4
24"	300	350	350		500	--	Refer Note-4
26" ≤ NPS ≤ 38"	300	350	350	--	--	--	Refer Note-6

NOTES :-

- All dimensions are in millimeter unless otherwise shown.
- The above projections are valid for all types of flanges.
- However in case of forged nozzle, the projection shall be suitably increased to meet reinforcement requirement.
- In case of manhole, projection shall be increased by the sum of 50 mm and difference of insulation thickness exceeding 50 mm.
- Projection from vessel axis to nozzle facing shall be rounded off to 10 mm.
- Flanges ≥ NPS 26" will be as per ASME B 16.47 series 'B'.

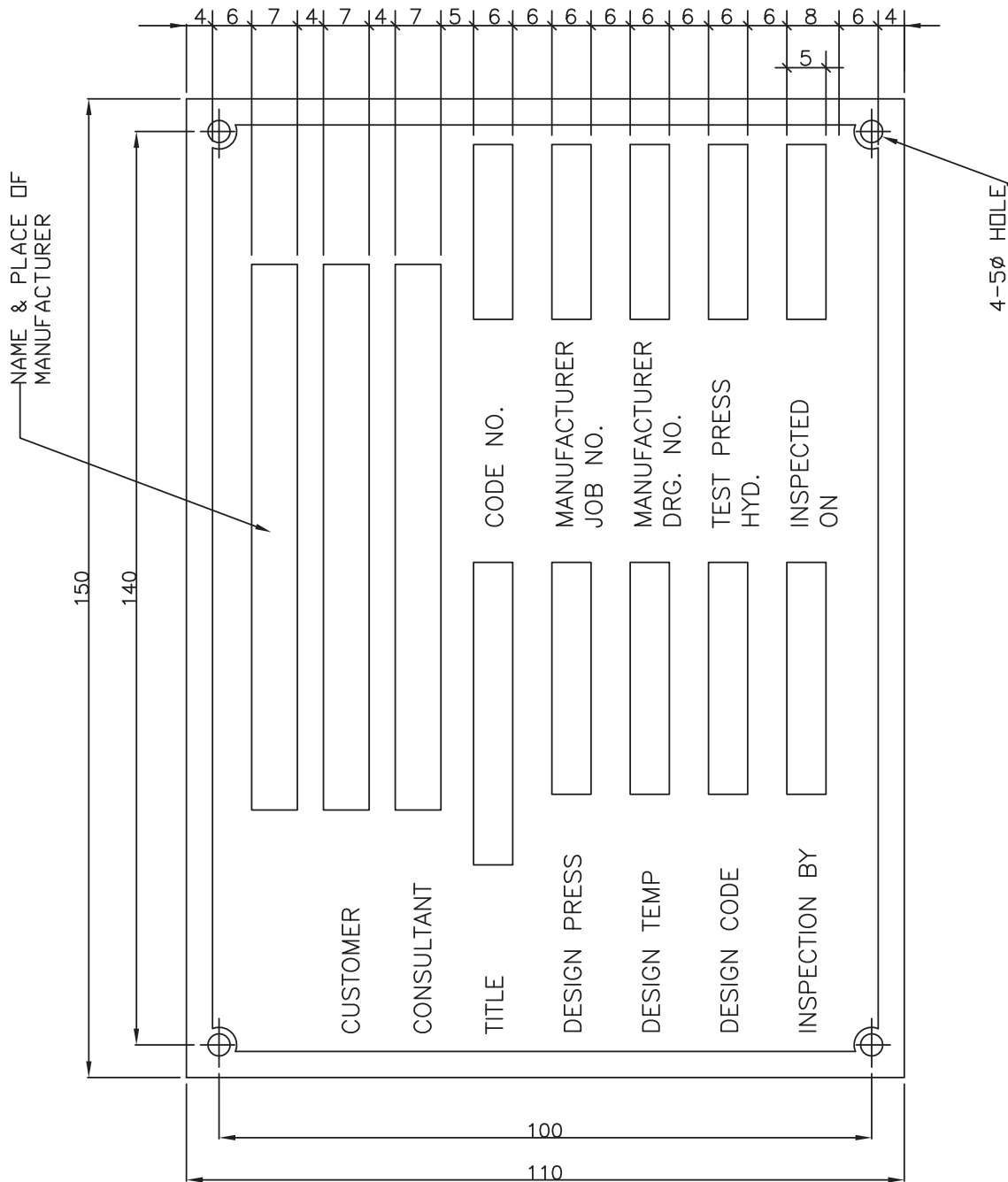
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DATE	PURPOSE	PREPARED	REVIEWED	APPROVED

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NAME PLATE FOR VESSEL & TOWER

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 SHEET 1 OF 2

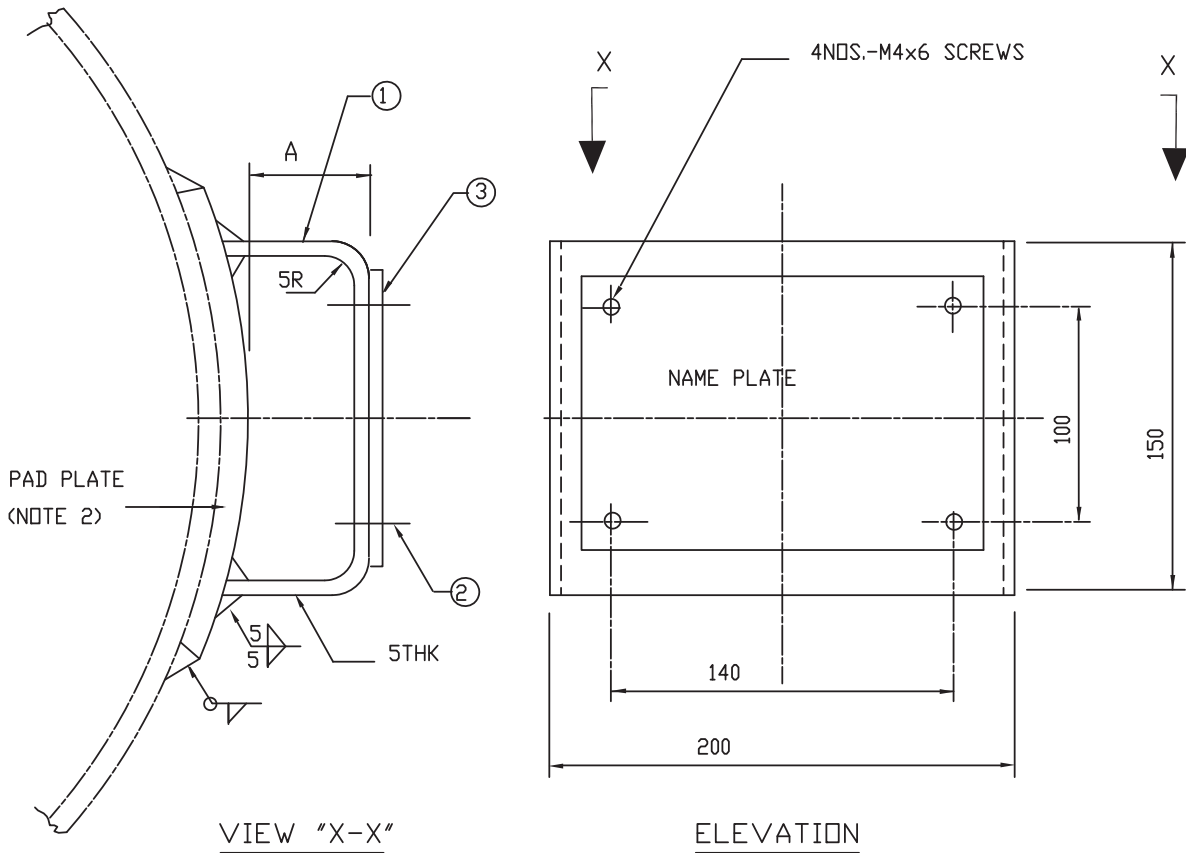


2 THK PLATE MATERIAL: 18/8 STAINLESS STEEL.

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NAME PLATE BRACKET



DIMENSION "A"

- a) VESSELS WITHOUT INSULATION = 25 mm
- b) VESSELS WITH INSULATION = INSULATION THK + 25 mm

NOTES:

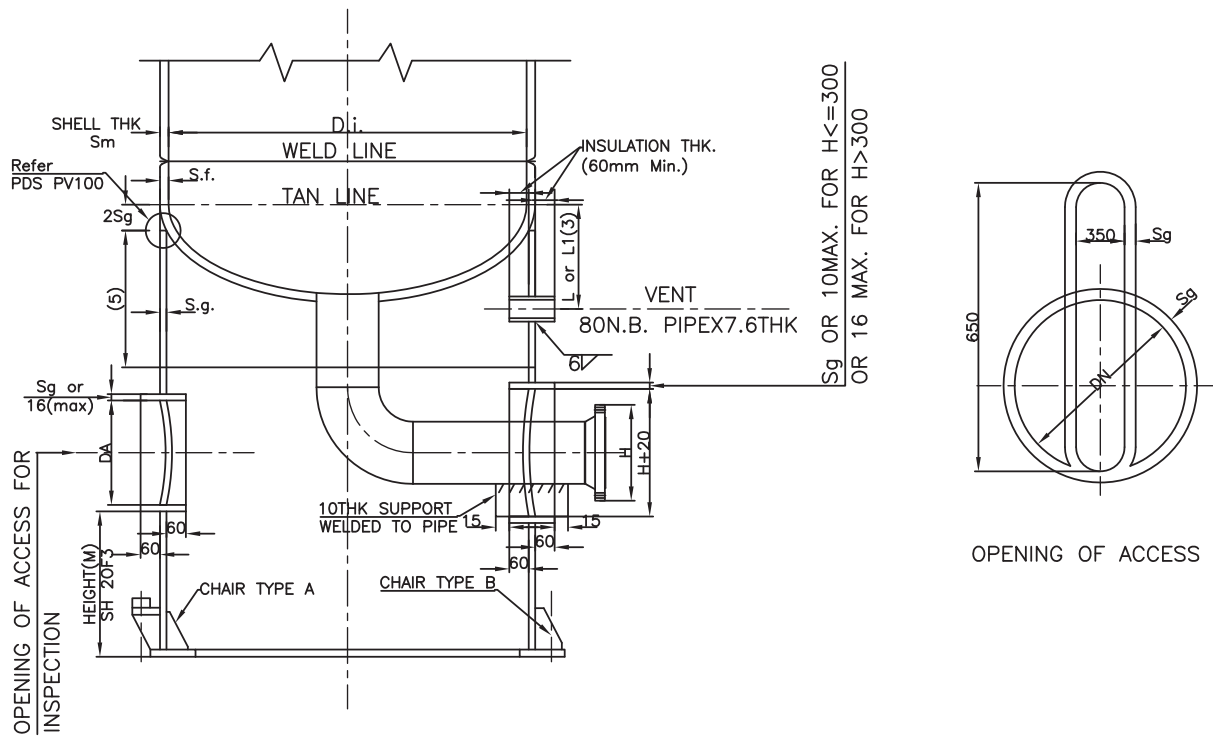
1 MATERIALS:

- BRACKET (1) IS 2062 Gr.A
- SCREWS (2) S.S.304
- NAME PLATE(3) S.S.304

- 2 PAD PLATE OF SIMILAR COMPOSITION AS THAT OF SHELL SHALL BE WELDED ON VESSELS OF MATERIALS OTHER THAN CARBON STEEL AND THOSE UNDER LOW TEMPERATURE SERVICE
- 3 ALL DATA BLOCKS AND LETTERS MUST BE CHEMICALLY ENGRAVED (< 0.5 m.m.)

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SKIRT DIAMETER DG	OPENING OF ACCESS			VENT		
	NO.	TYPE	DA	NO.	L	L1
≤ 700	1	CIRCULAR	250	2	260	230
701-1000	1	OVAL	350x650	2	290	250
1001-2500	1	CIRCULAR	500	4	400	360
2501-4000	2	CIRCULAR	500	8	550	450
4001-6000	2	CIRCULAR	500	12	670	560
> 6000	2	CIRCULAR	500	16	700	600

NOTES :-

- The No. dia and the type of bolt shall be decided as per design. The bolt circle dia. 'DF' shall be fixed according to design, sheet 2 & 3 illustrate chair details (TYPE A, B & C)
- For the skirt of conical(lapered) construction, the type and the no. of access opening and vent to be decided according to the dia. of skirt at corresponding elevation of centre line of opening.
- The values of 'L' & 'L1' are adopted for insulation thickness ≤ 90 mm. L for semielliptical head and 'L1' for torispherical head with $r/D = 0.1$. For other types of head and insulation thickness > 90 mm. 'L' & 'L1' shall be decided case by case.
- 'M' the minimum height of each opening, shall be such that it allows for mounting of nut for type 'A' and welding of gussets for type 'B' foundation bolt chairs.
- In case the head is made of S.S. or of special material and skirt in C.S., unless otherwise specified provide the skirt length at the same material as that of head with minimum length of 250mm. For high temperature service, the length and the material of the skirt shall be decided according to design condition.
- Where the skirt is attached to a stress relieved vessel the skirt to shell or head weld and at least 600mm of the skirt shall be stress relieved.

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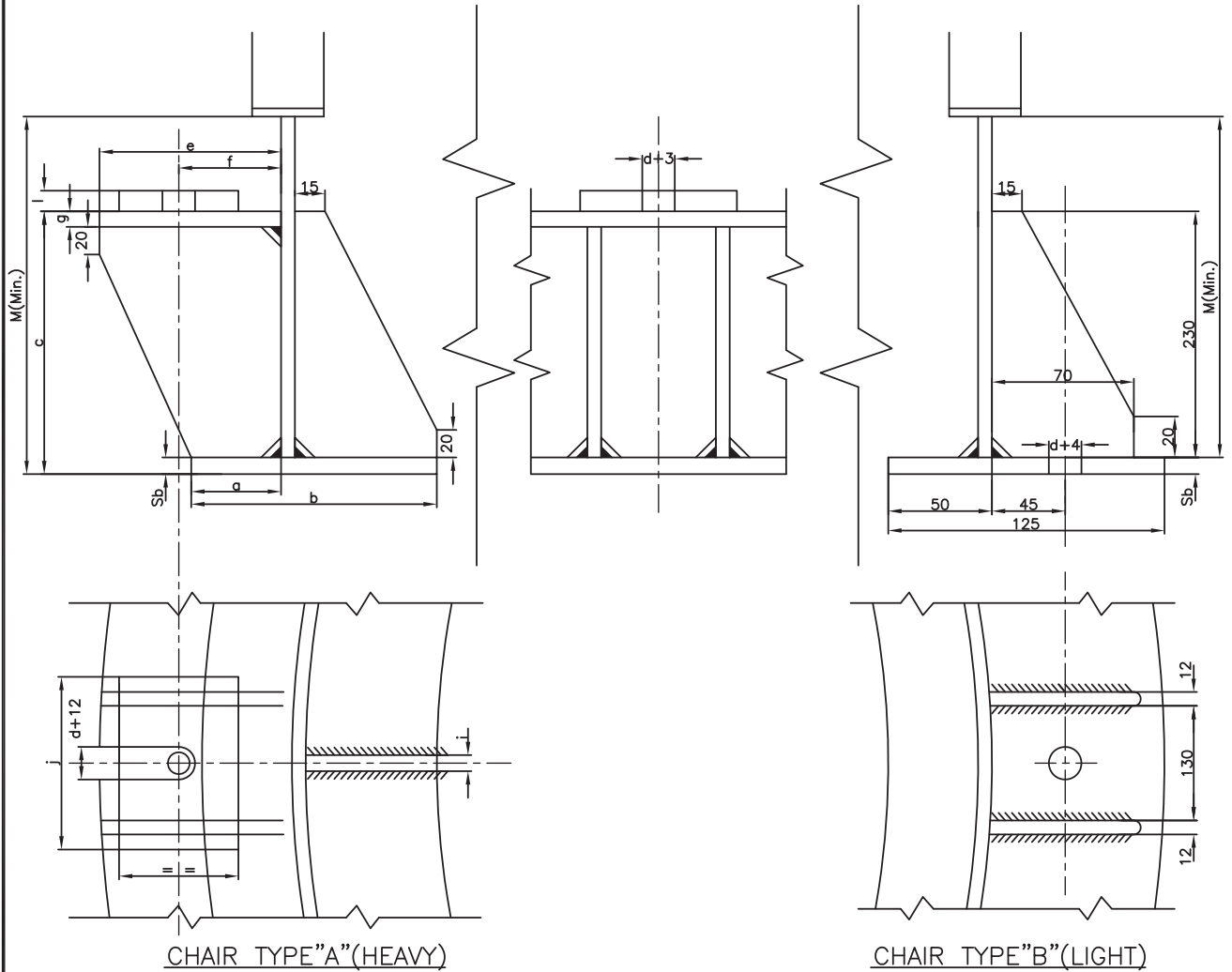


SKIRT SUPPORT FOR VERTICAL VESSELS

PDS:PV 301

ISSUE: SEP 2014

SHEET 2 OF 3

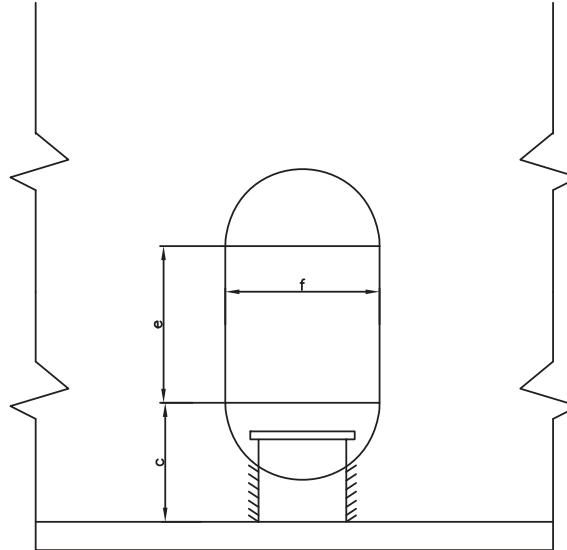
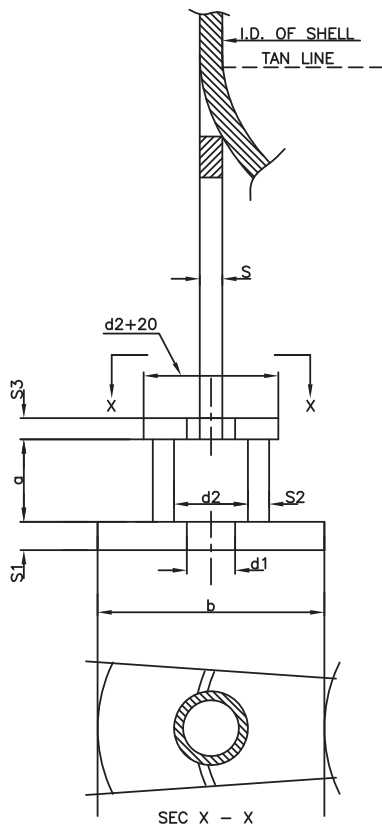


CHAIR TYPE	FOUNDATION BOLT DIA. (d)	a	b	BASE RING			CHAIR DIMENSIONS									M (Min.)
				25kg/cm ²	35kg/cm ²	45kg/cm ²	c	e	f	g	h	i	j	k	l	
B	M16-M27	SEE DETAIL	SEE DETAIL	20	25	28	SEE DETAIL									300
A	M30	50	130	20	25	28	250	125	75	14	70	12	105	80	32	420
	M33	50	130	20	25	28	250	130	76	14	75	12	110	90	32	436
	M36	55	140	22	28	32	280	145	84	14	80	12	115	100	36	480
	M39	55	140	22	28	32	280	150	84	16	85	14	125	110	36	490
	M42	60	150	25	28	32	300	160	92	16	90	14	130	110	40	525
	M45	60	150	25	28	32	300	165	92	18	95	16	140	120	40	535
	M48	65	170	25	32	36	330	180	100	18	100	16	150	130	45	580
	M52	70	180	28	32	36	360	190	110	20	105	18	160	140	50	625
	M56	70	180	28	32	36	360	200	110	20	110	18	170	150	56	645
M60	80	200	32	36	40	400	220	122	22	115	20	180	160	56	700	
M64	90	200	32	40	45	440	235	134	25	120	20	190	170	63	760	

NOTES :-

- The fillet size of the welding shall be equal to minimum of the thicknesses to be welded.

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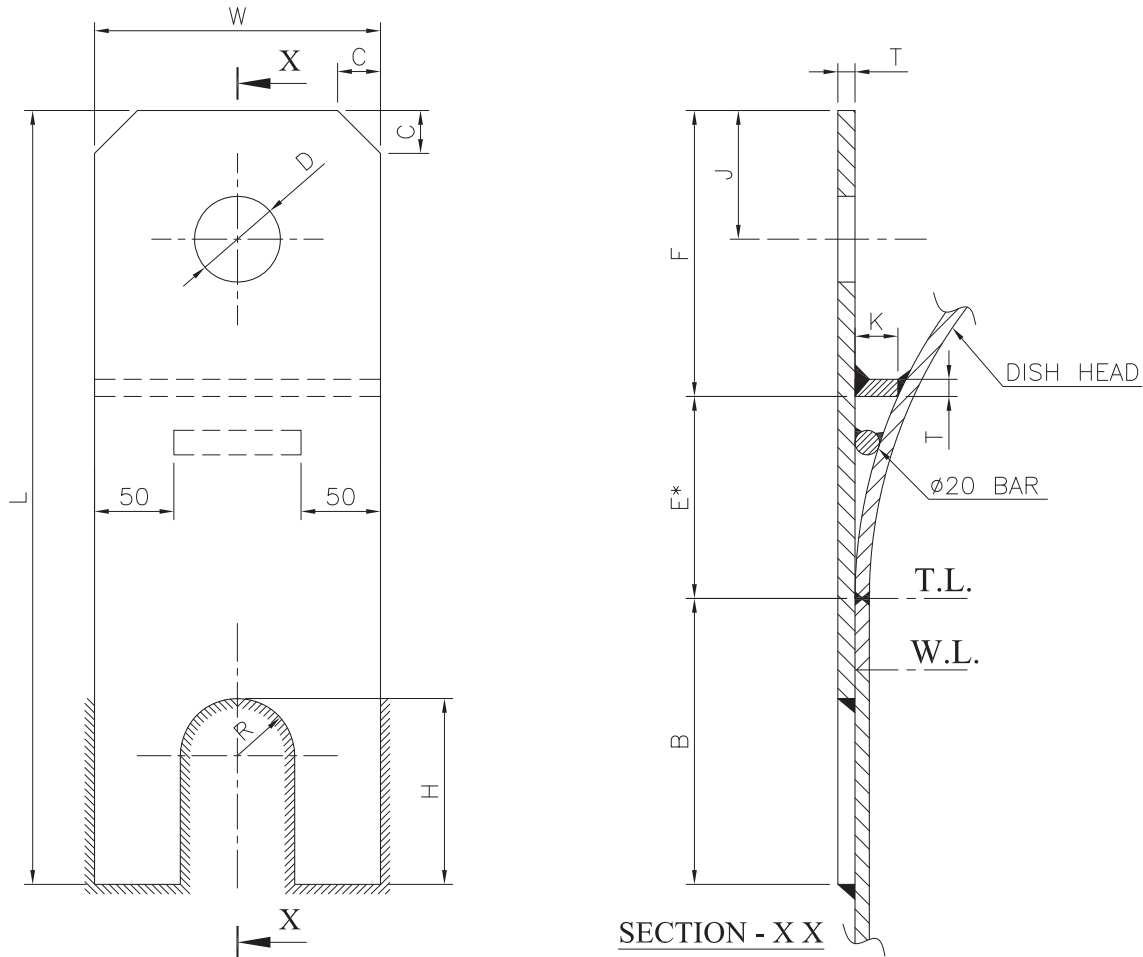


DIA. OF BOLTS	NO. OF HOLES	a	b	c	d1	d2	e	f	S1	S2	S3
20	SEE NOTE - 2	55	80	70	24	48	70	80	20	7	12
24		55	80	70	28	48	70	80	20	7	12
27		55	80	70	32	60	70	85	20	9	12
30		60	110	75	35	60	80	90	22	9	16
33		70	110	85	39	60	85	95	22	9	16
36		75	110	90	42	73	95	105	22	10	16
39		90	130	105	45	73	105	110	22	10	16
42		100	130	115	48	73	115	115	22	10	16
45		115	130	130	51	90	125	120	22	12	16
48		125	150	140	54	90	135	130	25	12	20
52		140	200	155	58	90	140	135	30	12	20

NOTES :-

1. The base ring can also be manufactured in four equal parts and the relating welding must be ground on both sides. The ring dimensions must be checked case by case on the basis of the specific loads.
2. The number of the anchor bolts shall be determined case by case and at any rate in a number multiple of four the type to be selected is a designers choice..
3. The fillet size of welding shall be minimum of the thicknesses to be welded.

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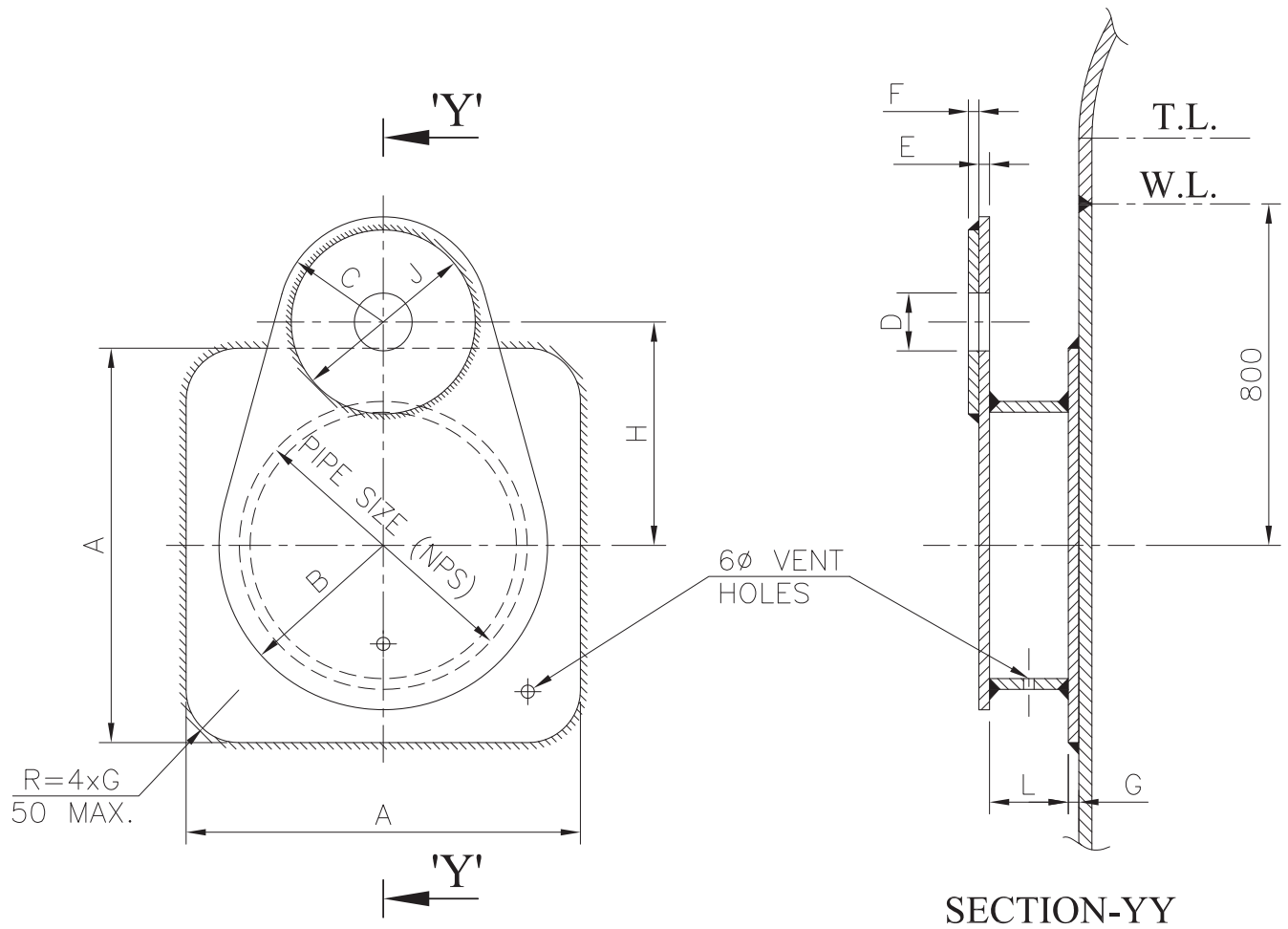
MAX. ERECTION WT OF VESSEL (M TON)	10	25	45	90	140	180
THICKNESS OF PLATE (T)	12	28	40	50	70	80
WIDTH (W)	200	230	300	400	500	615
LENGTH (L)	400+E	460+E	580+E	750+E	900+E	1080+E
DIAMETER OF HOLE (D)	60	75	75	100	130	150
HEIGHT OF NOTCH & SIDE WELD (H)	130	130	150	200	250	300
RADIUS OF NOTCH (R)	40	40	50	75	90	100
WELD SIZE	10	14	20	30	38	46
BOTTOM OF BRACE TO TOP OF LUG (F)	200	230	300	400	500	600
BOTTOM OF BRACE TO T.L. OF HEAD (E)	see note 2*					
T.L. OF VESSEL TO END OF LUG (B)	200	230	280	350	400	480
CHAMFER (C)	30	40	50	70	90	100
TOP OF LUG TO CENTER LINE OF LUG (J)	90	90	115	150	180	230
(K)	30	40	50	70	80	100
NO. OF LUGS (T)	2	2	2	2	2	2

NOTES :

1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE INDICATED.
2. DIMENSION 'E' TO BE DETERMINED BY SHAPE OF HEAD IN CONJUNCTION WITH DIMENSION 'K'.
3. DETAIL DIMENSIONS AND NOTES GIVEN IN DESIGN DRAWING TAKE PRECEDENCE OVER THOSE SHOWN HERE.

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LIFTING CAPACITY PER LUG (M. TON)	PIPE			PLATE								
	NPS	MIN. THK.	L	A	B	C	D	E	F	G	H	J
<5	6"	7.11	60	25	100	50	27	8	—	8	130	—
>5 ≤10	8"	8.18	85	300	125	80	38	8	—	8	170	—
>10 ≤20	8"	8.18	85	300	125	80	44	10	8	10	170	140
>20 ≤25	10"	9.27	100	350	150	120	54	12	10	12	210	220
>25 ≤30	12"	8.38	110	400	175	160	60	12	10	10	250	300

NOTES :

1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE INDICATED.
2. LIFTING CAPACITY RELATES TO PER LUG. THIS TYPE OF LUGS MAY BE USED TO LIFT UPTO 60 TONS.
3. WELDING SIZE SHALL BE 0.7 OF THICKNESS BUT NOT LESS THAN 7 MM.
4. MATERIAL PLATES—SA 516 Gr. 70 OR EQUIVALENT (SEE NOTE 5). PIPE—SA 106 Gr. B OR EQUIVALENT.
5. THE PLATE WELDED TO SHELL FOR ALLOY STEEL EQUIPMENT SHALL BE OF SAME MATERIAL OF THE SHELL.

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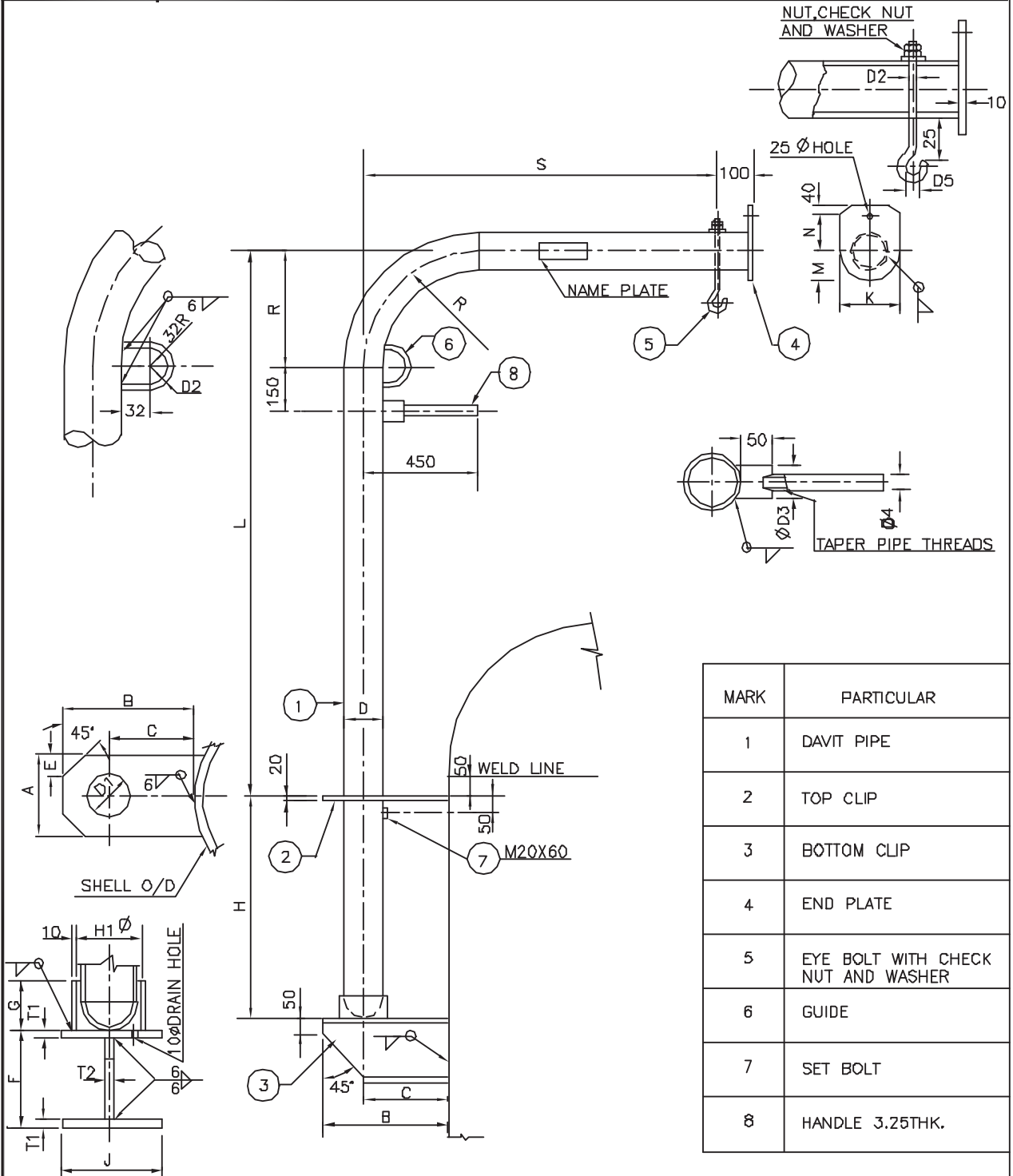
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PIPE DAVIT

PDS:PV 303

ISSUE: AUG. 1999

SHEET 1 OF 2



MARK	PARTICULAR
1	DAVIT PIPE
2	TOP CLIP
3	BOTTOM CLIP
4	END PLATE
5	EYE BOLT WITH CHECK NUT AND WASHER
6	GUIDE
7	SET BOLT
8	HANDLE 3.25THK.

NOTES:

- 1.FABRICATOR TO INDICATE IN PERMANENT LETTERING ON THE NAME PLATE THE RATED LOAD.
- 2.FABRICATOR TO MAKE SURE THAT DAVIT TURNS EASILY.
- 3.VESSEL CLIP PLATES TO BE OF THE SAME MATERIAL AS SHELL PROPER AND TO BE WELDED TO EACH OTHER AND TO SHELL WITH 6mm FILLET WELD.
- 4.FOR STRESS RELIEVED VESSELS,CLIP MUST BE SHOP WELDED TO VESSELS.
- 5.OTHER STRUCTURAL PARTS TO IS:2062 Gr A/B.
- 6.PIPE THREADS TO IS:554.

AUG. 99	ISSUED FOR IMPLEMENTATION			
DATE	PURPOSE	PREPARED	REVIEWED	APP'D.BY:



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PIPE DAVIT

PDS : PV 303

ISSUE : AUGUST 1999

SHEET 2 OF 2

Davit pipe size	A	B	C	D ₁	D ₃	D ₄	E	F	G	H ₁	J	K	M	N	T ₁	T ₂
DN 100	250	355	225	118	55	26.9	65	180	100	120	150	140	70	140	16	10
DN 150	300	400	250	172	70	42.4	75	200	100	175	200	190	95	160	16	10
DN 200	400	475	275	222	70	42.4	100	250	100	225	250	240	120	185	20	12

Davit type	Rated load 500 kg.				Davit type	Rated load 1000 kg.				S	L	H
	D DN x Tnk.	R	D ₂	D ₅		D DN x Thk.	R	D ₂	D ₅			
1	100 x 7.9	500	16 φ	40 φ						600	2300	750
2	100 x 7.9	500	16 φ	40 φ						700	2300	750
3	150 x 7.11	750	16 φ	40 φ	103	150 x 9.52	750	20 φ	50 φ	800	2500	750
4	150 x 7.11	750	16 φ	40 φ	104	150 x 9.52	750	20 φ	50 φ	900	2500	750
5	150 x 7.11	750	16 φ	40 φ	105	150 x 9.52	750	20 φ	50 φ	1000	2500	900
6	150 x 7.11	750	16 φ	40 φ	106	200 x 8.18	1000	20 φ	50 φ	1100	2500	900
7	150 x 7.11	750	16 φ	40 φ	107	200 x 8.18	1000	20 φ	50 φ	1200	2500	900
8	150 x 7.11	750	16 φ	40 φ	108	200 x 8.18	1000	20 φ	50 φ	1300	2800	1100
9	150 x 7.11	750	16 φ	40 φ	109	200 x 8.18	1000	20 φ	50 φ	1400	2800	1100
10	150 x 9.52	750	16 φ	40 φ	110	200 x 8.18	1000	20 φ	50 φ	1500	2800	1100
11	150 x 9.52	750	16 φ	40 φ	111	200 x 11.13	1000	20 φ	50 φ	1600	3000	1250
12	150 x 9.52	750	16 φ	40 φ	112	200 x 11.13	1000	20 φ	50 φ	1700	3000	1250
13	150 x 9.52	750	16 φ	40 φ	113	200 x 11.13	1000	20 φ	50 φ	1800	3000	1250
14	150 x 9.52	750	16 φ	40 φ	114	200 x 11.13	1000	20 φ	50 φ	1900	3000	1250
15	150 x 9.52	750	16 φ	40 φ	115	200 x 11.13	1000	20 φ	50 φ	2000	3000	1250
16	150 x 9.52	750	16 φ	40 φ	116	200 x 11.13	1000	20 φ	50 φ	2100	3300	1400
17	200 x 8.18	1000	16 φ	40 φ						2200	3300	1400
18	200 x 8.18	1000	16 φ	40 φ						2300	3300	1550
19	200 x 8.18	1000	16 φ	40 φ						2400	3300	1550
20	200 x 8.18	1000	16 φ	40 φ						2500	3300	1550
21	200 x 8.18	1000	16 φ	40 φ						2600	3300	1550

Controlled Copy

Copy Serial No. 01

Issued by: S. K. Upadhyay

Dated: *Upadhyay*

09.09.99 (Signature & Name)

31/08/99	ISSUED FOR IMPLEMENTATION	<i>JWS</i>	<i>Pcc</i>	
DATE	PURPOSE	PREPARED	REVIEWED	APPROVED

FORM NUMBER 02-0000-0021 F3 REV 0

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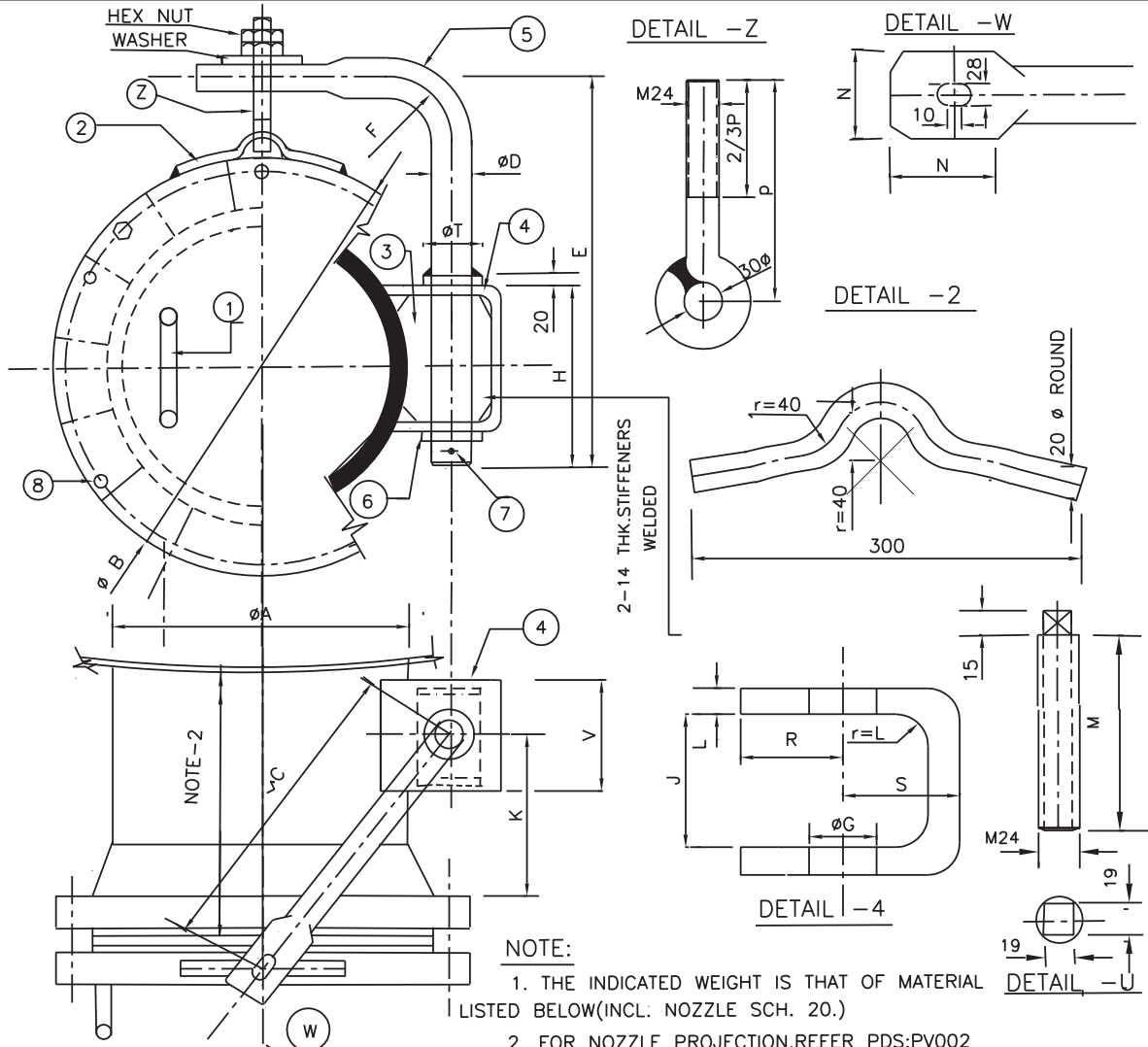
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DAVIT FOR MANHOLE WITH ASME FLANGE
FOR HORIZONTAL NOZZLE

PDS: PV 304

ISSUE: OCT. 1999

SHEET 1 OF 2



NOTE:

1. THE INDICATED WEIGHT IS THAT OF MATERIAL LISTED BELOW (INCL. NOZZLE SCH. 20.)
2. FOR NOZZLE PROJECTION, REFER PDS:PV002

SIZE DN	RTG PSI	A	B	C	NPS	E	F	G	H	J	K	L	M	N	P	R	S	T	V	WT KG
18"	150	457	635	370	2" SCH80	600	260	62	280	200	220	20	80	80	180	70	100	100	140	205
	300	457	711	390	2" SCH80	650	290	62	280	200	239	20	100	80	180	70	100	100	140	365
	600	457	743	440	3" SCH160	650	310	92	280	200	284	20	130	100	180	85	120	130	180	595
	900	457	787	485	3" SCH160	700	350	92	280	200	328	25	150	100	180	85	130	130	180	785
20"	150	508	698	395	2" SCH80	650	300	62	280	200	225	20	85	80	200	70	100	100	140	265
	300	508	775	435	3" SCH160	700	300	92	280	200	282	20	105	100	200	85	120	130	180	465
	600	508	813	465	3" SCH160	700	300	92	280	200	291	25	135	100	200	85	130	130	180	695
24"	150	610	813	445	2" SCH80	700	340	62	280	200	233	20	90	80	200	70	100	100	140	365
	300	610	914	485	3" SCH160	750	360	92	280	200	269	20	110	100	200	85	120	130	180	675
	600	610	940	520	3" SCH160	750	400	92	280	200	303	25	150	100	200	85	130	130	180	1095

8	JACK SCREW SEE DETAIL U	IS:2062 GRA/B	3	
7	COTTER PIN	IS:2062 GRA/B	1	
6	WASHER	IS:2062 GRA/B	1	
5	DAVIT PIPE	SA:106 GR B	1	
4	DAVIT BRACKET	SAME AS NOZZLE	1	
3	BRACKET STIFFENERS	SAME AS NOZZLE	2	
2	HOLDING ROD/HOOK	SAME AS NOZZLE	1	
1	HANDLE	SAME AS COVER	1	
PART NO.	DESCRIPTION	MATERIAL	QUANTITY	OBSERVATIONS

04.10.99	ISSUED FOR IMPLEMENTATION			
DATE	PURPOSE	PREPARED	REVIEWED	APP'D. BY:

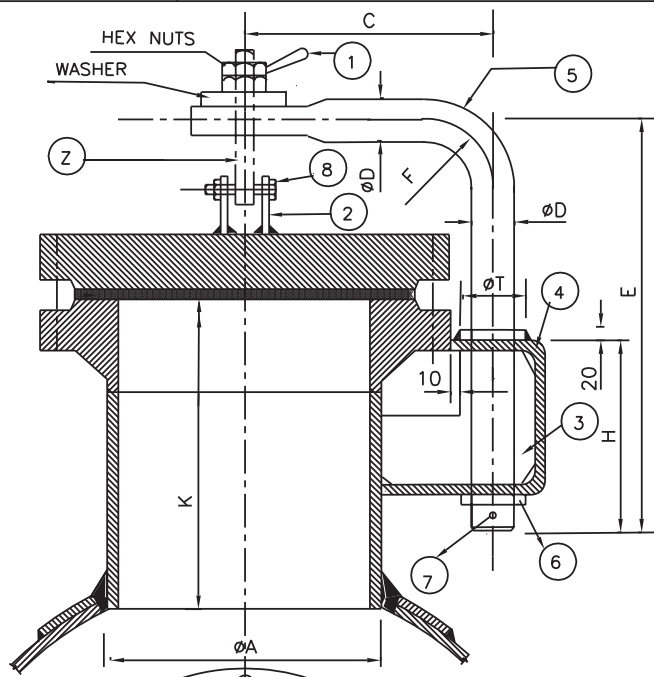
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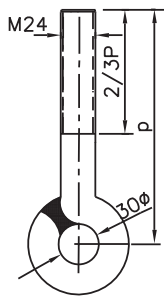
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DAVIT FOR MANHOLE WITH ASME FLANGE
FOR VERTICAL NOZZLE

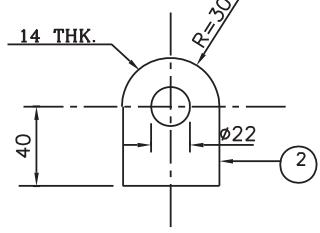
PDS: PV 304
ISSUE: OCT. 1999
SHEET 2 OF 2



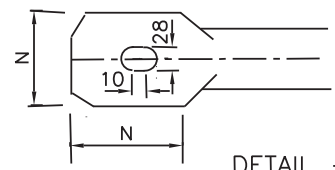
DETAIL -Z



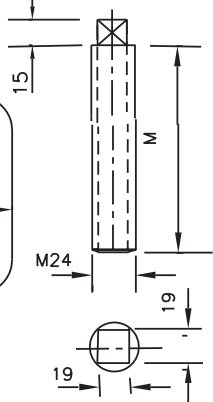
DETAIL -2



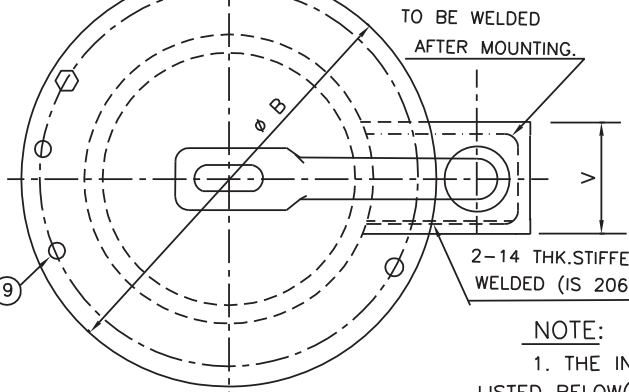
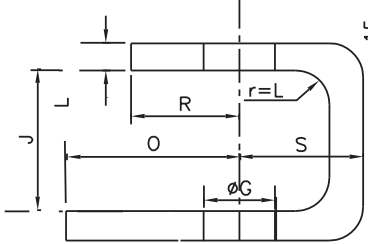
DETAIL -W



DETAIL -U



DETAIL -X



NOTE:
1. THE INDICATED WEIGHT IS THAT OF MATERIAL LISTED BELOW (INCL. NOZZLE SCH. 20.)

SIZE DN	RTG PSI	A	B	C	NPS	E	F	G	H	J	K	L	M	N	O	P	R	S	T	V	WT KG
18"	150	457	635	390	2" SCH80	550	300	62	220	150	REFER PDS:PV 002	20	80	80	159	300	70	100	100	140	205
	300	457	711	430	2" SCH80	600	340	62	220	150		20	100	80	197	300	70	100	100	140	370
	600	457	743	460	3" SCH160	750	340	92	280	200		20	130	100	228	350	85	120	130	180	615
	900	457	787	480	3" SCH160	800	360	92	280	200		25	150	100	250	350	85	130	130	180	800
20"	150	508	698	420	2" SCH80	550	300	62	220	150		20	85	80	165	300	70	100	100	140	260
	300	508	775	465	3" SCH160	650	340	92	220	150		20	105	100	206	300	70	100	100	180	450
	600	508	813	480	3" SCH160	700	340	92	280	200		25	135	100	238	350	85	120	120	180	665
	900	508	851	500	3" SCH160	800	360	92	280	200		20	110	100	237	350	85	120	130	180	675
24"	150	610	813	480	2" SCH80	600	360	62	220	150		20	90	80	172	350	70	100	100	140	365
	300	610	914	545	3" SCH160	650	410	92	220	150		20	110	100	237	350	85	120	130	180	675
	600	610	940	560	3" SCH160	850	440	92	280	200		25	150	100	250	450	85	130	130	180	1095

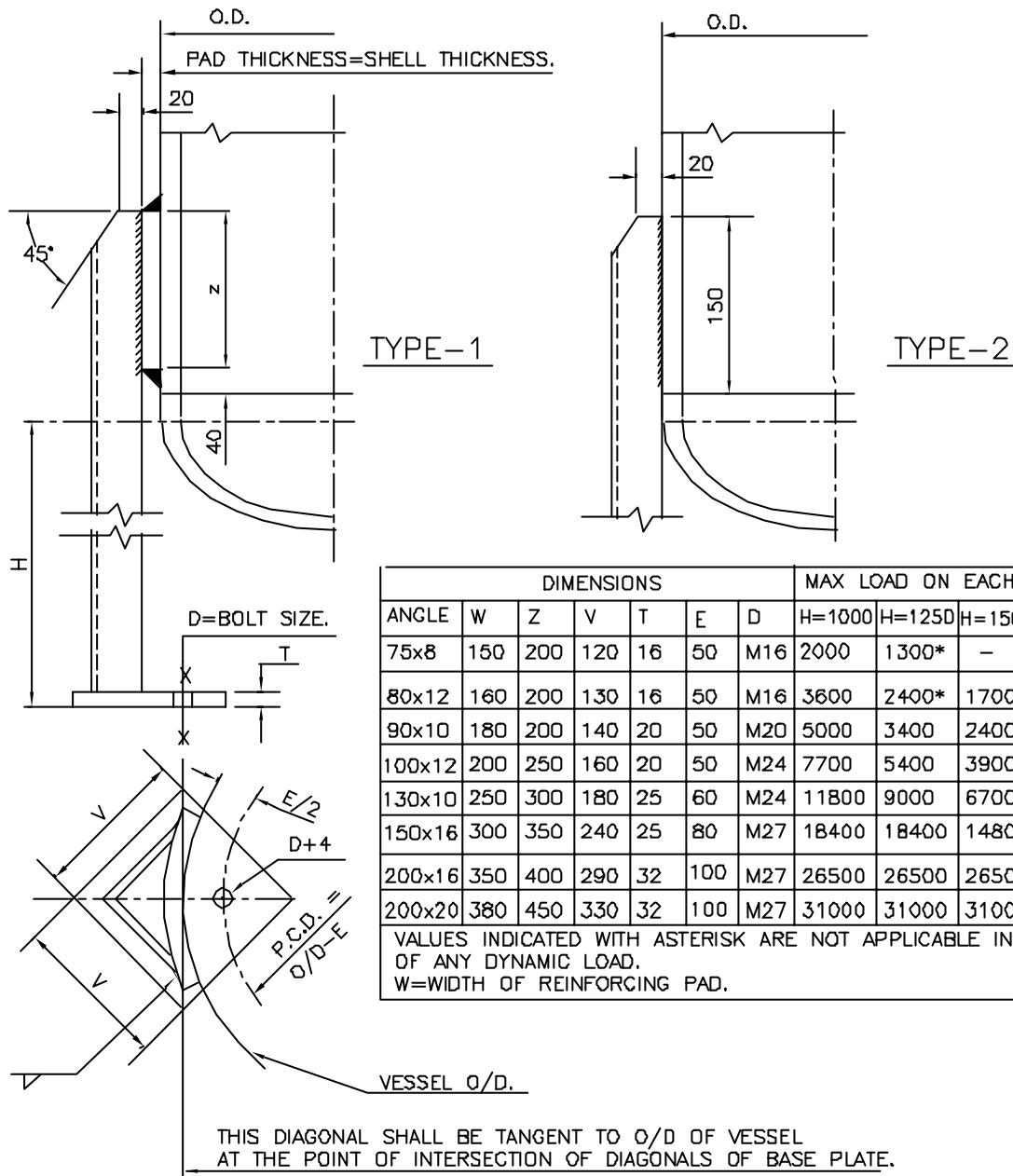
PART NO.	DESCRIPTION	MATERIAL	QUANTITY	OBSERVATIONS
9	JACK SCREW SEE DETAIL U	IS:2062 GRA/B	3	
8	BOLTS & HEX NUTS	-	AS REQUIRED	
7	COTTER PIN	IS:2062 GRA/B	1	
6	WASHER	IS:2062 GRA/B	1	
5	DAVIT PIPE	SA:106 GR B	1	
4	DAVIT BRACKET	SAME AS NOZZLE	1	
3	BRACKET STIFFENERS	SAME AS NOZZLE	2	
2	HOLDING PLATE	SAME AS NOZZLE	2	
1	HANDLE	IS:2062 GRA/B	1	

04.10.99	ISSUED FOR IMPLEMENTATION			
DATE	PURPOSE	PREPARED	REVIEWED	APP'D. BY:



PDIL LEG SUPPORT FOR VERTICAL VESSELS

PDS:SR 300
 ISSUE: AUG. 1999
 SHEET 1 OF 1



ANGLE	DIMENSIONS						MAX LOAD ON EACH LEG 'P' IN KG.				
	W	Z	V	T	E	D	H=1000	H=1250	H=1500	H=1750	H=2000
75x8	150	200	120	16	50	M16	2000	1300*	-	-	-
80x12	160	200	130	16	50	M16	3600	2400*	1700*	-	-
90x10	180	200	140	20	50	M20	5000	3400	2400*	1800*	-
100x12	200	250	160	20	50	M24	7700	5400	3900*	2900*	-
130x10	250	300	180	25	60	M24	11800	9000	6700	5100	3900*
150x16	300	350	240	25	80	M27	18400	18400	14800	11600	9300
200x16	350	400	290	32	100	M27	26500	26500	26500	22000	15500
200x20	380	450	330	32	100	M27	31000	31000	31000	31000	26000

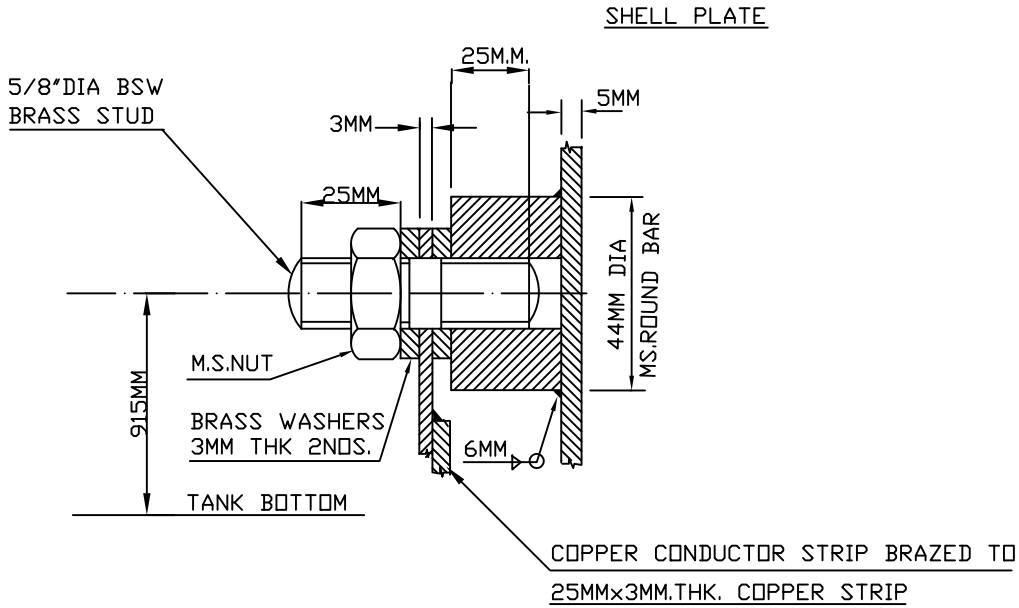
VALUES INDICATED WITH ASTERISK ARE NOT APPLICABLE IN PRESENCE OF ANY DYNAMIC LOAD.
 W=WIDTH OF REINFORCING PAD.

NOTES

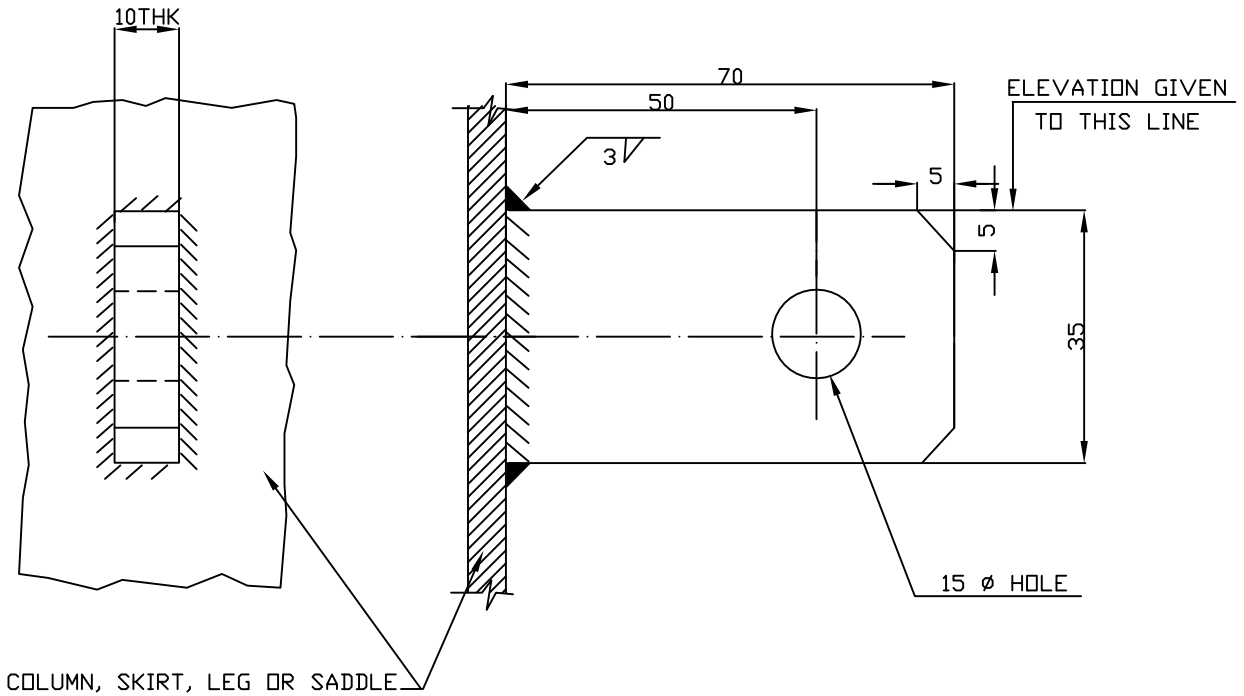
- WEIGHT ON EACH LEG 'P' $\geq Q/N + M/C$ IN KG, WHERE
 Q= WT OF VESSEL FULL OF LIQUID KG.
 N=NO OF LEG SUPPORTS
 M=WIND MOMENT IN Kg cm.
 C=0.75XP.C.D OF FOUNDATION BOLTS FOR 3 LEGS IN CM.
 C=P.C.D OF FOUNDATION BOLTS FOR 4 LEGS IN CM.
- FOR VESSELS = < 1000 O/D ADOPT 3 NO OF SUPPORTS.
 AND VESSELS >1000 O/D ADOPT MIN. 4 NO. OF SUPPORTS.
- SUPPORT TYPE 2 SHALL BE USED ONLY FOR TANK = < 600 O/D.
- DIMENSION 'H' AND TYPE OF SUPPORT ARE TO BE DECIDED AS PER DESIGN CONDITION.
- REINFORCING PAD SHALL BE OF SAME MATERIAL AS THAT OF SHELL.
- ALL CORNERS OF REINFORCING PAD SHALL BE ROUNDED TO RADIUS OF 20 MM.
 FOR CARBON AND NICKEL STEEL VESSELS OPERATING AT LOW TEMPERATURES,
 MINIMUM CORNER RADIUS SHALL BE OF 50 MM.
- ALL WELDS SHALL BE CONTINUOUS, SIZE OF FILLET WELD SHALL BE EQUAL TO THE MINIMUM THICKNESS TO BE WELDED.
- ADOPT SKIRT SUPPORT (PDS:PV 301)PREFERABLY FOR VESSEL HAVING HEIGHT TO DIAMETER RATIO >5.

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EARTHING BOSS FOR STORAGE TANKS



EARTHING CLEAT

SEP. 2014	ISSUED FOR IMPLEMENTATION	ENGG. COMM.		
DATE	PURPOSE	PREPARED	REVIEWED	APP'D.BY

 पी डी आई एल PDIL	PROJECTS & DEVELOPMENT INDIA LTD	PC183/E/4018/P-VI-3.1.4	0	
		DOCUMENT NO	REV	
		SHEET 1 OF 6		


SECTION – VI 3.1.4

DESIGN SPECIFICATION – PIPING

PLANT: COAL/PETCOKE/LIMESTONE HANDLING FROM RAILWAY SIDING TO STORAGE YARD

NIT NO- PNMM/PC183/E-4018/NCB

PROJECT: INTEGRATED COAL BASED FERTILIZER COMPLEX AT TALCHER, ANGUL, DISTRICT- ODISHA, INDIA



 पी डी आई एल PDIL	DESIGN SPECIFICATION – PIPING (FOR PACKAGE UNITS)	PC183/E/4018/P-VI-3.1.4	0	
		DOCUMENT NO	REV	
		SHEET 2 OF 6		

CONTENTS

SECTION NUMBER	DESCRIPTION	SHEET NUMBER
1.0	GENERAL PIPING SCOPE OF WORK	3
2.0	DESIGN & DETAILED ENGINEERING	3
3.0	PROCUREMENT & SUPPLY BY BIDDER	4
4.0	INSPECTION	4
5.0	PAINTING	5
6.0	CONSTRUCTION	5
7.0	BIDDER'S RESPONSIBILITY	5
8.0	DRAWING/ DOCUMENTATION SCHEDULE	6
9.0	PACKAGING	6
10.0	DOCUMENTATION WITH BID	6

LIST OF ATTACHMENTS

SL NO.	DOC.NO.	DESCRIPTION	NO.OF SHEETS
1	EM0000-PNMP-TS951	DESIGN PHILOSOPHY- PIPING	45
2	TFL-PDS-600	PIPING MATERIAL SPECIFICATION	162

	DESIGN SPECIFICATION – PIPING (FOR PACKAGE UNITS)	PC183/E/4018/P-VI-3.1.4	0	
		DOCUMENT NO	REV	
		SHEET 3 OF 6		

1.0 GENERAL PIPING SCOPE OF WORK

1.1 The detail scope of work includes such as, but not limited to, complete management, Design, Detailed Engineering, 3D modelling, Stress Analysis, to provide all the necessary data, drawings, documents required as per the project requirements, Procurement, Supply, Transportation of materials, shop & site Fabrication, Erection, Installation, Supporting, Non-Destructive Testing (NDT) & required Inspection, pre-heating, dye-penetrant test, Magnetic Particle Test, post weld heat treatment, radiography, Ultrasonic test, Testing, Flushing, Air drying, blowing, cardboard-blasting, seal/leak-testing, Pre-Commissioning, Trial run, Commissioning and Guarantee of all the associated works pertaining to complete piping system and related facilities for Coal/Petcoke/Limestone handling from Railway Siding to Storage Yard package at TFL, TALCHER.

1.2 Design, material, fabrication and erection shall be in accordance with latest edition of ASME B31.3 chemical plant and petroleum refinery piping code. The dimensions, manufacturing tolerances shall conform to applicable standards.

1.3 All works described in this package shall be performed in accordance with the design-basis, specifications, drawings, and other requirements of NIT and shall be subject to Owner's review and approval.

1.4 MATERIAL OF CONSTRUCTION

Materials as per internationally acceptable code shall be used for piping based on service requirement. All materials for piping Components shall conform to ASTM or API Specifications as per enclosed piping specifications. All piping materials and valves shall be procured from the approved suppliers/vendors.

1.5 Cost of piping job shall also include the cost of supervision, Labour, overheads / profits, materials, consumables, scaffolding and all other associated arrangements required to execute the related activities of this package.

1.6 PIPING INTER - CONNECTION

Piping lines as per P&ID shall be provided at battery limit which shall be indicated later by Owner. Bidder shall provide valve at battery limit for respective piping system of the package unit.

1.7 SPARES

Mandatory spares shall be quoted by bidder as per spares section of NIT.



2.0 DESIGN AND DETAILED ENGINEERING BY BIDDER

2.1 Collection of all data/ information furnished in the NIT and additionally collected/ generated by Bidder.

2.2 Finalization of design data/ basis for carrying out design, detailed Engineering for complete scope of work as per project specifications, contained in the NIT.

2.3 Performing design and detailed engineering of the following:

- a) Complete piping system for the package unit.
- b) Carry Out all necessary calculations in accordance with approved design basis, drawings / documents and requirements of the NIT.
- c) Finalization of layouts for the unit and preparation of construction drawing, preparation of piping drawings, equipment layouts, piping general layout drawings (GAD's) , pipe supports, piping isometrics. Typical indicative sketches/drawings included in NIT document shall be taken as broad basis for developing the layouts. Since the availability of free space is limited, Bidder shall plan its piping layouts in such a way so as to minimize the area requirement while giving due importance to ease of access, operation

	DESIGN SPECIFICATION – PIPING (FOR PACKAGE UNITS)	PC183/E/4018/P-VI-3.1.4	0	
		DOCUMENT NO	REV	
		SHEET 4 OF 6		

and maintenance of the facilities installed by the Bidder. The fabrication/erection & all other piping jobs shall be carried out as per drawings/documents approved by Owner.



- d) Carrying out Material Take Off for the entire piping system for the package unit.
- e) The detail design shall take into consideration of local Statutory Regulation, if any, for the package unit.

3.0 PROCUREMENT & SUPPLY BY BIDDER

- 3.1 Bidder shall procure and supply all materials whatsoever required for temporary/permanent installation of piping system in sequence and at appropriate time. All equipments, materials, components etc shall be suitable for the service and the design life of the system.
- 3.2 Bidder shall procure all materials, components, equipments, consumables etc required for successful completion of the piping system. Bidder shall also procure spares required for pre-commissioning and commissioning/start-up as recommended for all the items supplied by him as per specifications provided in the NIT. Where no specifications are available in the contract, the same shall be prepared by the Bidder, and shall be subject to Owner's approval.
- 3.3 Material take-off (linewise and consolidated) with complete description of size, rating, material, thickness and specifications.
- 3.4 Preparation and finalization of data sheets for all piping materials e.g. all valves etc. All data-sheets shall be subject to review and approval by Owner.
- 3.5 Preparation of Material requisitions, Request for Quotation & its evaluation and recommend Bidders for Owner's approval. Preparation of purchase requisitions, review of Bidder's drawings and calculations, approval of manufacturing procedures wherever necessary, and the party inspection at manufacturer's works of the materials by reputed agencies as required. Quality control and expediting of all procured items at Bidder's shop or at fabrication yard.
- 3.6 Bidder shall procure materials as per specifications and list of approved Vendors/Suppliers (for major Items) included in the bid document.
- 3.7 Carry out proper documentation of inspection and quality assurance programs for all equipment and bulk materials duly approved by Owner. Bidder shall maintain an accurate and traceable listing of procurement records for the location, quality and character of all permanent materials in the Project.
- 3.8 Bidder shall immediately report to the Owner of all changes which will affect material quality, and take necessary corrective actions. Purchase requisitions including Purchase Orders of all major items shall be approved by Owner. For balance items, records shall be furnished for information only.
- 3.9 Compliance with Bidders and supplier's instructions and recommendations for transportation, handling, installation and commissioning.

4.0 INSPECTION

- 4.1 Inspection authority means the Third Party Inspection Agencies (TPIA) approved by the Owner to carryout inspection of materials.
- 4.2 The inspecting authority shall have the right to select random samples for check test and reject materials, if samples furnished as above and tested as per the specifications fail to meet the requirement specified.
- 4.3 All the items shall be inspected and tested in the presence of one or more representatives of the purchaser during various stages of manufacturing. Material shall be considered acceptable for dispatch only after final certificate of acceptance is issued by the Inspector.

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- 4.4 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.
- 4.5 Quality Assurance plan (QAP) / Inspection Test Plan (ITP) shall be submitted by bidder for approval by Third Party Inspection Agency (TPIA).
- 4.6 Scope of Inspection by TPIA:
- Review of Chemical composition report, MTC (all batches)
 - Positive Material Identification (PMI) for Alloy/Stainless steels (10% random witness)
 - Hydrostatic test (10% random witness)
 - Non Destructive Examination- Report review
 - Dimensional check, Marking, Visual check for surfaces, external appearance (10% random witness)
 - Packing: Report review

5.0 PAINTING

Painting shall be as per specification attached elsewhere in NIT.

6.0 CONSTRUCTION

All construction works be carried out as per “Approved for Construction” drawings, procedures, specifications and applicable codes and standards. Any changes at site shall also need prior approval from the Owner/PMC and revision of drawings.



Bidder shall procure and supply all materials whatsoever required for temporary/permanent installations of piping system in required and at appropriate time. All equipment, materials, components etc. shall be suitable for the intended service and the design life of the system. Wherever no specification is available in the contract, the same shall be prepared by the Bidder and shall be subject to Owner approval.

After completion of erection jobs, all piping system will be suitably hydraulically tested as per the test pressure indicated in the line list / relevant document approved by owner.

7.0 BIDDER’S RESPONSIBILITY

All works shall be carried out by Bidder in accordance with the drawings / documents / specifications indicated in the subsequent paragraphs.

- 7.1 Specifications
- 7.2 Standards
- 7.3 Piping Support Standards
- 7.4 Drawings
- 7.5 Design Review
- 7.6 Bidder shall submit all proposal designs, analysis, drawings, installation and testing procedure for review & approval by Owner as mentioned in the scope work. Bidder shall as a minimum, provide above deliverables for Owner’s information / records & review / approval.
- 7.7 Typical Plot Plan drawing of package unit is attached in the NIT. This drawing is INDICATIVE only and is furnished for Bidder’s information. Issued for construction (IFC) drawings shall be prepared by Bidder after detailed engineering being done by him and shall be subject to approval by the Owner.

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7.8 The Bidder shall submit separately, the material take off for piping, valves, fittings and all other accessories as per requirements.

7.9 Bidder shall obtain statutory approval from various authorities having jurisdiction over the area, as necessary, for construction of the unit package.

8.0 DRAWINGS/ DOCUMENTATION SCHEDULE

Bidder shall furnish all the drawings/ documents to Owner for comments/ approval. He shall incorporate all comments/modification suggested by Owner. The drawings/documents should be properly organised, supplied & submitted as per documentation schedule of NIT.

Number of sets shall be as stipulated elsewhere in the tender document. Final documentation shall be supplied in hard copies (4nos.) as well as soft copies.

9.0 PACKAGING

9.1 Items shall be thoroughly dried, cleaned and shall be free from moisture, dirt & loose foreign materials, with ends protected from mechanical damage during transportation, shipment & storage.

9.2 For transportation overseas, protection and packing shall be adequate to prevent damage from sea atmosphere.

10.0 DOCUMENTATION WITH BID

Following drawings/documents must be submitted along with the bid.

i) Proposed equipment layout drawing.

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DESIGN PHILOSOPHY – PIPING

PACKAGE UNITS

INTEGRATED COAL BASED FERTILIZER COMPLEX AT TALCHER, ANGUL, DISTRICT- ODISHA, INDIA

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5.2	Unit Piping
5.3	Offsite & Yard Piping
5.4	Flare Piping
5.5	Underground Piping
5.6	Air Systems
5.7	In-Line Instruments
5.8	Sample Connections
5.9	Vents and Drains
5.10	Line Strainers
5.11	Spectacle Blinds
5.12	Flexibility Analysis and Supporting
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LIST OF ATTACHMENTS

DOCUMENT/ANNEXURE NUMBER	DESCRIPTION
1	Table Of Basic Span
2	Accessibility For Valves & Instruments
3	Vertical And Horizontal Guides Spacing
4	Clearances
5	Design Philosophy For Stress Analysis
5A	Criteria for Identifying Extremely Critical Lines (Level I)
5B	Criteria for Identifying Moderately Critical Lines (Level II)
5C	Minimum allowable nozzle loadings: Vessels and S/T heat exchangers

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1.0 SCOPE

The scope of this document is pertaining to the design philosophy, norms and specific requirements which shall be adhered to by contractor or his associates and representatives during the course of the project in designing, procurement & construction of piping material.

1.1 APPLICABLE STANDARD & CODES

Standard No.	Title
ASME/ANSI B16.5	Steel Pipe Flanges and Flanged Fittings
ASME/ANSI B16.9	Steel Butt-Welding Fittings
ASME/ANSI B16.10	Face to Face and End to End Dimensions of Valves
ASME/ANSI B16.11	Forged Fittings Socket Welded and Threaded -
ASME/ANSI B16.20	Metallic Gaskets for Pipe Flanges – Ring Joint, Spiral Wound, and Jacketed.
ASME/ANSI B16.21	Non-Metallic Flat Gaskets for Pipe Flanges
ASME/ANSI B16.25	Butt-Welding Ends
ASME/ANSI B16.34	Valves – Flanged, Threaded Welding End.
ASME/ANSI B16.47	Large Diameter Steel Flanges
ASME/ANSI B31.1	Power Piping
ASME/ANSI B31.3	Process Piping
ASME/ANSI B31.5	Refrigeration Piping
ASME/ANSI B36.10M	Welded and Seamless Wrought Steel Pipe.
ASME/ANSI B36.19M	Stainless Steel Pipe
API 6D	Specification for Pipe Line Valves (Gate, Plug, Ball and Check Valves).
API 6FA	Fire Test for Valves
API 501	Specifications for Metallic Gaskets for Refinery Piping
API 594	Check Valves:, Wafer-Lug and double flanged type
API 598	Valve Inspections and Testing
API 599	Steel Plug Valves, Flanged and Butt-weld ends
API 600	Steel Gate Valves, Flanged and Butt-welding ends, Bolted Bonnets
API 602	Gate, Globe, and Check Valves for Sizes DN 100 (NPS 4) and Smaller for the Petroleum and Natural Gas Industries
API 603	Class 150 – Corrosion Resistant Flanged End gate valves.
API 604	Ductile Iron gate valves – flanged ends.
API 606	Compact C.S. Gate Valve extended body.
API 607	Fire Test for soft seated Ball Valve.
API-608	Metal Ball Valves, Flanged, Threaded & BW Ends.
API 609	Butterfly Valves, Lug type & Wafer type
API 623	Steel Globe Valves—Flanged and Butt-welding Ends, Bolted Bonnets
IBR	Indian Boiler Regulations
AWWA C207-D	Large Dia. Steel Flanges (Ring Type).
EJMA	Expansion Joints Manufacture Association
MSS SP 6	Standard Finishes for Contact Faces of Pipe Flanges and Connecting End Flanges of Valves and Fittings
MSS SP 25	Standard Marking System for Valves, Fittings, Flanges & Unions
MSS SP 43	Wrought Stainless Steel Butt-weld Fitting

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MSS SP 45	By-pass and Drain Connection
NACE MR0175-94	Sulphide Stress Cracking resistant Metallic Material
NFPA	National Fire Protection Association
EN 10204	Metallic Products - Types of Inspection documents
ASTM D3035	Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter
ASTM D3261	Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing

2.0 DESIGN PHILOSOPHY

2.1 Piping systems shall be in accordance with Clause 1.1, which permits the use of the following specifications:

ASME B31.1 Power Piping

ASME B31.3 Process Piping

Materials, design, construction, testing and inspection shall be fully in accordance with the selected specification.

2.2 The dimensions, manufacturing tolerances and marking of ferrous and non ferrous piping components shall conform to the applicable standards .The design shall comply with all applicable codes, laws and statutory regulations. The Contractor shall optimize the layout with the approval of the owner and include any changes resulting from HAZOP studies and taking into consideration the following :

- i) General site layout taking into account the topographical geo-technical aspect of the site.
- ii) Access for maintenance and fire appliances.
- iii) The interdependency of units and buildings with each other within the complex.
- iv) Safety escape routes for personnel based on emergency or disaster management plans in the event of environmental upset or fire.
- v) Suitable drainage system of Project site.

2.3 Material of construction shall be suitable for specified process duty (both normal and abnormal operations) and have a projected life and corrosion/ erosion allowance in excess of minimum life of the project. Piping materials specified in piping materials specification shall be used for selection of material of construction of major services.

All materials under steam service shall be supplied with proper certificates in prescribed forms.

3.0 CODES, STANDARDS AND SUPPLEMENTARY SPECIFICATIONS

3.1 The latest edition of codes shall be applicable for piping system design, materials, fabrication, manufacture, erection, construction and inspection etc. For any item not covered in the list of codes and standards / International Standards / proven design may be finalized based on discussion with OWNER/Consultant.

3.2 Where conflict occurs, the order of precedence shall be:

- a) Statutory Regulations
- b) National, International and Industry Standards and Codes of Practice.
- c) Technical Specifications

3.3 Standards, Codes and Supplementary Specifications for piping design shall be applied as follows:

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- i) Process and utility piping to ASME B31.3 Process Piping
- ii) Power Plant piping to ASME B 31.1
Fire protection system shall be designed and installed in accordance with applicable NFPA (National Fire Protections Associations) Codes.

4.0 GENERAL DESIGN

- 4.1 Flanges for process and utility piping shall be in accordance with ANSI B16.5 and ANSI B16.47.
- 4.2 Wherever possible all purchased equipment shall be supplied with flanges that comply with ANSI B16.5/B16.47.
- 4.3 The minimum size of piping to be used in pipe-racks shall be 2" NB.
- 4.4 With the exception of equipment connections the minimum size of piping shall be ½" NPS.
- 4.5 Pipe sizes 1 ¼", 2 ½", 3 ½" 5" and 22" NPS shall not be used except as connections to purchased equipment.
- 4.6 Threaded pipe nipples between headers and vent, drain and instrument isolation valves shall be Schedule 160 for CS and Schedule 80S for SS in the size range ½" to 2" NPS.
- 4.7 Piping 2" NPS and above shall be butt-welded. All weld joints in piping 1½" NPS and below shall be socket welded using socket weld fittings.
- 4.8 In Class 900 and higher pressure rating double block valves shall be used for systems open to atmosphere, such as vents and drains. Piping in hazardous service shall have vents, drains and bleeds routed to a safe location. Category 'M' substances shall be vented to the flare system.
- 4.9 When a line of one material specification is connected to a line of higher material specification, the connecting line shall be constructed of the higher material specification or pressure rating up to & including the first block valve.
- 4.10 As a minimum, piping systems shall have isolation facilities as follows:
ASME B31.3 Category 'M' service and Normal service (Class 900 and above) shall have double block isolation valves with a downstream drop-out spool.
ASME B31.3 Normal service (upto Class 600) shall have a valve and downstream spectacle blind.
ASME B31.3 Category 'D' service shall have a valve and downstream spectacle blind.
Generally, equipment shall have provision for isolation of piping to each equipment connection by means of valving and /or blinds as determined by service conditions.

5.0 DESIGN PHILOSOPHY / GENERAL CRITERIA

5.1 Equipment Layout

5.1.1 Basis of Equipment Layout

Equipment Layout shall be finalised based on the following data:

- a) Overall Plot Plan
- b) P&I Ds
- c) Equipment Data Sheets
- d) Wind Direction
- e) Safety Distance and Specific Distance mentioned in Piping Design Basis and as

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per statutory requirements.

5.1.2 Development of Equipment Layout

The following aspects shall be considered during development of equipment layout.

- a) Process Requirement -Proper interconnection between equipment as per P&I Ds to achieve the intended process parameters.
- b) Economy of piping material- Minimize the quantity of costly piping.
- c) Erection & Construction requirements:
Erection scheme and schedule of all equipment must be considered during equipment layout to have smooth erection mainly in case of tall columns, heavy equipments like thick walled reactors, space for laying tall columns, approach roads for cranes / derricks for lifting the column or reactors and requirement of special foundation / pile etc.
- d) Operation and Maintenance Requirement
 - Overhead and side clearances for exchangers and pumps
 - Horizontal & overhead clearances for easy movement of working personnel.
 - Crane approaches for air coolers/fired heaters.
 - Provision of monorail for pumps and exchangers
- e) Similar equipment grouping - All columns, exchangers, pumps etc. should be grouped together for convenience of maintenance and safety wherever feasible.
- f) The technological structures should be interconnected for easy movement of operational personnel.
- g) U/G piping corridors for main headers should be marked in equipment layout for all under ground piping.

5.1.3 Plant Layout & Design guidelines

5.1.3.1 General

The plant layout shall be based on ensuring adequate access, to allow construction, inspection, maintenance and operation to be performed in a safe and efficient manner. The alignment of equipment and pipe shall offer an organised appearance. The layout shall be in accordance with, but not limited to the design practices described in this criteria.

Where dynamic loading, limited pressure drop or other severe service condition applies, particular care shall be taken in routing pipe lines.

Flushing connections shall be provided on all lines containing flammable or toxic material, slurries, and materials which solidify- when the line is dead. Sufficient Nitrogen purging points shall also be provided. Supply piping of fuel gas shall be arranged for equal flow distribution.

Trolley beams, pipe davits, shall be provided with appropriate removable hoists mechanism for charging and discharging catalysts, chemicals, packing rings etc.

Piping and all other services shall be arranged so as to permit ready access of Cranes for removal of Equipment for inspection and servicing.

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All utility and process piping shall be located above ground, and major lines shall be located in overhead pipe ways.

Lines that must be run below grade, and must be periodically inspected or replaced, shall be identified on the P & ID's; these lines must be placed in covered concrete trenches. Sleeper ways shall not be used in process areas where they may block access for personnel and equipment.

Drip legs and dead ends shall be avoided, especially for piping where solids or fluids may congeal from corrosive condensate.

Where sleeper ways are used the elevations shall be staggered to permit ease of crossing or change of direction at intersections. Flat turns may be used when entire sleeper ways change direction. Flat turns must not be used within pipe racks.

Spacing and routing of piping shall be such that expanding/contracting lines (including insulation) will not clash with adjacent lines, structures, instruments and electrical equipment during warm up and cool down.

Piping to be sloped shall be indicated on the P&I D's.

5.1.3.2 **Pipe-Rack/T-Post/Small Portals**

In general, equipment layout shall be prepared considering straight pipe rack, however other shapes like L / T / U / H / Z etc can also be considered based on area available.

The width of the rack shall be 4M, 6M, 8M, 10M or 12M for single bay having four (4) tiers maximum. In general, the spacing between pipe rack portals (span) shall be taken as 8 M for main rack. However it can be decreased to 6 M depending on the size/number of the pumps to be housed below pipe rack. Intermediate Beams between two portals shall be provided to support smaller pipes $\leq 2"$. 20% extra space shall be provided on the pipe rack and portals on each tier for future expansion/modifications.

-Clearance beneath pipe rack shall be 3.8 M minimum.

-Height between two pipe rack tiers shall be 2.0M minimum.

-Road clearance shall be 9 M minimum wherever heavy duty crane movement is required during construction and future maintenance.

-Road clearance shall be 7.5 M minimum for main roads.

-Road clearance shall be 5 M minimum for secondary roads.

-T-Portal's width shall not be more than 2.5 M and height shall not be less than 3.0 M

5.1.3.3 **Pumps**

Wherever practical, pumps shall be arranged in rows with the centre line of the discharge on a common line. In general, pumps shall be kept inside the pipe rack. However in case of smaller racks, pumps shall be kept on one side or outside the pipe rack to provide clear access under the rack as per clause applicable.

Pump foundation height shall be 300 mm above H.P.P.

Gap between each pump foundation / and foundation of technical structure should be sufficient for easy removal of equipment after piping. Clearance between two adjacent pumps shall be such that clear 900 mm aisle is available.

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All pumps not open to sky with motor rating ≥ 45 KW shall be provided with monorail. No monorail should normally be provided for pumps outside rack and sufficient space below rack shall be available for pump maintenance.

5.1.3.4 **Clearance and Accessibility**

5.1.3.4.1 **Access to Pumps**

Clear access of 3.8M vertically and 4.5M horizontally shall be provided centrally under main pipe rack for small mobile equipment to service pumps, wherever these are put under pipe ways with prior specific approval. Pumps outside rack shall be approachable by small cranes etc. from under the pipe rack.

5.1.3.4.2 **Access to lower items to grade (Lowering Area)**

Clear access shall be provided at grade on the access side for lowering external and internal fittings from tall elevated equipment by providing pipe davits.

5.1.3.4.3 **Layout & Access Requirements for Platforms ladders and Stairs**

For providing platform ladder & staircase following guidelines shall be followed.

- Two means of access (i.e. two ladders or one ladder and one stair case) shall be provided at any elevated platform which serves three or more vessels & for B/L valves operating platform.
- Platforms, ladders and stairways shall be the minimum, consistent with access and safety requirements.
- Stairway for tanks to be provided on upstream of predominant wind direction.
 - i) Platform at elevated structure
 - a) Dual access (i.e. one staircase and one ladder) shall be provided at large elevated structure if any part of platform has more than 22.65M (75 ft) of travel.
 - ii) Platforms with stair access shall be provided for:
 - a) Location at which normal monitoring (once a day or more) is required or where samples are taken.
 - b) Locations where vessels or equipment items need operator attention "such as compressors, heaters, boilers etc.
 - iii) Platforms with ladder access shall be provided for:
 - a) Points which require occasional operating access including valves, spectacle blind and motor operated valves, heater stack sampling points.
 - b) Man ways above grade on equipment.
 - iv) Ladder location
 - a) Wherever practicable, ladder shall be so arranged that users face equipment or platform rather than facing open space.
 - b) Landings shall be staggered. No ladder shall be more than 6 M in one flight.

5.1.3.5 **Clearances**

Minimum clearances shall be as indicated in Annexure.

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5.2 Unit Piping

5.2.1 Basis of Unit Piping

- Piping & Instrument Diagram
- Equipment layout
- Equipment Data sheet & Setting plan
- Line list
- Instrument Data sheet
- Structural & building drawings
- Topography of the plant
- Piping material specification
- Overall plot plan
- Tie in point drawing.

The following objective shall be ascertained during piping layout.

- Proper access to all operating points including valves, and for all orifice tapping points and instruments in particular.
- Proper access to interrelated operating points for specific purpose and for maintenance.

5.2.2 Pipe Ways/Rack piping

- 5.2.2.1 Racks shall be designed to give the piping shortest possible run and to provide clear head rooms over main walkways, secondary walkways and platforms.
- 5.2.2.2 Predominantly process lines are to be kept at lower tier and, utility & hot process lines on upper tier.
- 5.2.2.3 Generally the top tier is to be kept for Electrical (if not provided in underground trench as per electrical design basis) and Instrument cable trays. Cable tray laying to take care of necessary clearances for the fire proofing of structure.
- 5.2.2.4 Generally the hot lines and cold lines shall be kept apart in different groups on a tier. .
- 5.2.2.5 Generally the bigger size lines shall be kept nearer to the column.
- 5.2.2.6 Minimum spacing between adjacent lines shall be decided based on O.D of bigger size flange'(minimum rating 300# to be considered), O.D of the smaller pipe, individual insulation thickness and additional 25 mm clearance, preferably. Wherever even if flange is not appearing the minimum spacing shall be based on above basis only. '
- 5.2.2.7 Actual line spacing, especially at 'L' bend and loop locations, shall take care of thermal expansion / thermal contraction / non expansion of adjacent line. Non expansion / thermal contraction may stop the free expansion of the adjacent line at "L' bend location.
- 5.2.2.8 Anchors on the racks are to be provided on the anchor bay, if the concept of anchor bay is adopted. Otherwise anchors shall be distributed over two to three consecutive bays.
- 5.2.2.9 Anchors shall be provided within unit on all hot lines leaving the unit.
- 5.2.2.10 Process lines crossing units (within units or from unit to main pipe way) are normally provided with a block valve, spectacle blind and drain valve. Block valves are to be grouped and locations of block valves in vertical run of pipe are preferred. If the block valves have to be located in an overhead pipe way, staircase access to platform above the lines shall have to be provided.

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- 5.2.2.11 Provision of block valves, blinds etc. shall be as per Process Design Basis and P & IDs.
- 5.2.2.12 All small bore piping shall be designed in a way so as to ensure adequate space for maintenance and operation. For small bore piping intermediate support shall be provided in between portals.
- 5.2.2.13 Stubs on saline water (if applicable) service shall be from top of main header.
Minimum branch size for tapping including for instruments e.g. PG/PTI TE etc. shall be of 3" NPD and 150 mm height on internal cement lined pipes.
- 5.2.2.14 Aboveground lines shall be grouped to run on pipe racks or sleepers in so far as practicable.
- 5.2.2.15 Hot lines on pipe racks or sleepers shall be grouped and expansion loops shall be nested together. The number of expansion loops shall be kept to a minimum.
- 5.2.2.16 Piping handling corrosive fluids shall be run under piping handling non corrosive fluids, and shall not, where possible, be run overhead across walkways or normal passages for personnel.
- 5.2.2.17 All process and utility piping will be located aboveground within the plant battery limit, except water mains.
- 5.2.2.18 All piping shall be arranged in horizontal banks, where possible, to facilitate supporting.
Banks running north-south shall be at different elevations from banks running east-west. Exceptions are permitted to avoid unnecessary change in elevation at change of direction or where essential to avoid pockets.
- 5.2.2.19 All piping shall be routed for the shortest possible run and have the minimum number of fittings consistent with provision for expansion and flexibility. All piping shall be arranged in a neat manner, providing free access around all operating equipment.
- 5.2.2.20 Vertical lines at vessels shall run close to the vessel shell to facilitate supporting. The line shall be arranged and grouped to allow the use of single support.
- 5.2.2.21 Lines carrying molten solids, slurries or highly viscous liquids shall have a sufficient slope for each gravity flow.
- 5.2.2.22 The shortest and most direct layout possible shall be provided for gravity flow lines, especially when the fluid is subject to solidification and when the differential pressure is small.
- 5.2.2.23 Piping shall be arranged to facilitate handling of equipment for inspection or maintenance.
- 5.2.2.24 Vapor collecting system shall be routed so that the vapor rises continuously from the vessel being vented to a higher point without pocketing.
- 5.2.2.25 Pockets shall be avoided in lines, particularly those carrying corrosive chemicals, slurries, vents, blow down lines, etc.
- 5.2.3 Column / Vessel Piping Control Valves**
- 5.2.3.1 Piping shall be supported from cleats welded on the vessel as far as possible.
- 5.2.3.2 Proper guides at intervals shall be provided for long vertical lines.
- 5.2.3.3 Access platforms/ladders shall be provided along the column for valves and instruments.

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- 5.2.3.4 For ease of operation and maintenance, column and vessels which are grouped together, shall have their platforms at the same elevation interconnected by walkways wherever feasible. However each column \ vessel shall have an independent access also. Column vessel platforms should be designed in such a way so that all the nozzles should be approachable from platforms.
- 5.2.3.5 Unless specifically indicated in P&ID's control valves shall preferably be kept at grade instead of platform.
- 5.2.3.6 Piping intended for vacuum services shall be routed as short as possible, with minimum bends and flanged joints.
- 5.2.3.7 Piping support cleats shall be designed for safety valves considering impact loading during popping off.
- 5.2.4 **Pump Piping**
- 5.2.4.1 Pump drives shall have clear access.
- 5.2.4.2 Pump suction piping shall be as short as possible and shall be arranged with particular care to avoid vapor pockets.
- 5.2.4.3 Reducers immediately connected to the pump suction shall be eccentric type flat side up to avoid the accumulation of gas pocket. For end suction pumps, elbows shall not be directly connected to the suction flange. A straight piece minimum 3 times the line size shall have to be provided at the suction nozzle.
- 5.2.4.4 Pump discharge check valve if installed in vertical lines shall be fitted with a drain connection as close as possible downstream of the valve.
- When a suction vessel operates under vacuum, the vent connection of the pump has to be permanently connected to vapour space of the suction vessel to allow possible filling of the pump with liquid before it is started.
- 5.2.4.5 Unless otherwise specified T -type strainers shall be used on pump suction piping for sizes 2" and above.
- 5.2.4.6 Y-type strainers to be used for all sizes in steam services and for pump suction lines 1½ and below.
- 5.2.4.7 All small bore piping connected to pump (drain to OWS & CBD, seat and gland leak drain) shall have provision for break up flanges for removal of pumps.
- 5.2.4.8 Piping shall be so arranged that forces and moments imposed on the pump nozzle do not exceed the allowable values as per API 610.
- 5.2.4.9 Pump discharge should preferably be routed away from the pump rather than towards the motor side.
- 5.2.4.10 Pump cooling water connection shall be taken from the top of circulating cooling water header.
- 5.2.5 **Steam Header & Supply Lines / Steam and Condensate Systems**
- 5.2.5.1 Steam piping shall be designed to have complete condensate removal. Drip legs shall be provided with steam traps at low points in the system.
- 5.2.5.2 All steam branch connections shall be taken from the top of the header.

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5.2.5.3 Return exhaust steam / condensate lines shall connect to the top of the exhaust steam Condensate header.

5.2.5.4 Where block valves have been installed in the main steam header such that condensate can collect either side of the valve when closed, a safe means of draining the condensate prior to opening the valve shall be provided.

- Steam header shall be located generally on the upper tier and at one end of the rack adjacent to columns.
- Branch lines from horizontal steam header, except condensate collection points, shall be connected to the top of the pipe header.
- Isolation valves (if provided) on the branch line shall preferably be provided on the horizontal run and outside the pipe rack.
- All branch lines shall be drainable.
- Drip legs & steam traps shall be provided at all low points and dead ends of steam header. Drip legs at low points shall be closer to downstream riser and shall be provided to suit bidirectional flows, if applicable.
- All turbines on automatic control for startup shall be provided with a steam trap in the steam inlet line.
- All traps shall be provided with strainers if integral strainers are not provided.
- Steam traps discharging to atmosphere shall be connected to storm water drain/storm sewer, in case of open system. In case of condensate recovery, traps shall discharge into condensate header.
- Expansion loops are to be provided to take care of the expansions within units.
- Wherever condensate is to be drained, proper condensate draining facility shall be provided.

5.2.6. **Water Piping**

5.2.6.1 Water piping shall be designed to minimize the possibility of water hammer.

5.2.6.2 Water main headers may run underground to prevent freezing.

5.2.6.3 Unless local code or regulation prohibits, firewater lines shall be underground to prevent freezing. Firewater piping system shall conform to regulations of the competent governmental authorities.

5.2.7 **Instrument Air Piping**

5.2.7.1 Instrument air lines shall not be connected to process lines, service lines, and other equipment.

5.2.7.2 Instrument air shall not be used as plant air or service air.

5.2.7.3 Branch lines from the instrument air header shall be taken from the top of the header and shall be provided with a block valve close to the header. Also in the upstream of Instrument manifold, Gate valve has to be provided.

5.2.8 **Supports and Anchors**

5.2.8.1 Supports and/or anchors shall be provided close to changes in direction of lines, branch lines

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and, particularly, close to valves to prevent excessive sagging, vibration and strain.

- 5.2.8.2 Allowable spans between pipe supports shall be determined to keep the maximum deflection within 16 mm.
- 5.2.8.3 In cases where periodic maintenance requires removal of equipment, such as pumps and relief valves, and where lines must be dismantled for cleaning, piping shall be supported to minimize the necessity of temporary supports.
- 5.2.8.4 Spring-loaded hangers may be used on piping subject to thermal expansion or contraction. In cases where the movement is very large, or the limitation of reaction and stress are very severe, constant support spring hangers shall be used.
- 5.2.8.5 Suction and discharge lines of rotating equipment shall be supported as close as possible to equipment nozzles, and shall be relieved of excessive strains by using proper pipe supports.
- 5.2.8.6 Supports shall not be directly welded to pipes. Where welding is unavoidable, supports having the same chemical composition as pipe shall be carefully welded.
- 5.2.8.7 All piping shall be properly supported to minimize vibration.
- 5.2.8.8 Outlet piping of safety and relief valves shall be supported so that the inlet piping is capable of withstanding the reaction caused by operation of safety and relief valves. Furthermore, the supports shall be designed to minimize the stresses due to thermal expansion and the stresses in the valve body due to the weight of piping.
- 5.2.8.9 Expansion joints shall be guided and anchored to the extent necessary for their proper operation and alignment.
- 5.2.8.10 Anchors shall provide sufficient fixation to substantially transmit all load effects into the foundations.
- 5.2.8.11 Underground piping shall be given special anchoring consideration for differential settlement.

5.2.9 **Utility Stations**

Requisite number of utility stations shall be provided throughout the unit to cater for the utility requirement. Utility stations shall have four connections one for LP steam (SL), one for Plant Air (AP), one for Service Water (WS) and one for nitrogen each of 1.0" with isolation valves unless otherwise specified in P&ID.

Utility connection with nitrogen shall be provided with NRV along with isolation valve kept at a separate location other than this cluster @ 15 M.

Air and water lines shall have quick type hose connection and steam line shall have flanged type hose connection. All connections shall be directed downward. All connections shall have globe valve for isolation purpose. An inter connection with valve shall be provided between steam and service water lines shall be provided. Inert gas hose, when required, shall have built in non return valve in quick connection coupling of piping end.

Number of utility stations shall be such that all equipments shall be approachable from at least one utility station. The approach of utility station shall be considered 15 M all around the station location.

The Utility stations shall generally be located adjacent to pipe-rack column.

The utility stations shall also be provided on elevated structures like - technological structure, operating platforms of vertical equipments etc.

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Operating platforms having manholes must have a utility station. Utility station locations shall be limited to a height of 35 M from H.P.P.

5.3 Offsite & Yard Piping

In general, offsite piping (except tank ages area), electrical cable and instrumentation cable shall also be laid either on pipe rack or pipe sleepers.

Wherever piping is laid on pipe sleepers, it shall have hard surfacing below it keeping a gap of 300 mm from the bottom of the pipes. Hard surfacing should be completed before start of pipe laying. Width of hard surfacing shall be about 1.0 meter more than the piping corridor. This extra hard surfacing shall be for movement of operating personnel along the piping corridor.

Pipes at road crossing shall be under culverts in general. Overhead pipe bridges may be used for areas where pipe racks are provided. Where culverts are not provided, pipe sleeves shall be used for underground road crossing. Culverts / overhead pipe bridges shall be adequately designed to take care of future requirements. Minimum 20% extra width shall be provided in all such structures.

Clearances between lines shall be minimum "C" as given below:

$C = (D_o + D_f) / 2 + 25 \text{ mm} + \text{Insulation thickness}(es)$ where,

D_o - outside diameter of smaller pipe (mm)

D_f - outside diameter of flange of bigger pipe (mm)

However this 'C' spacing between the offsite piping on the rack/sleeper can be suitably increased so that the lines should not touch each other after insulation / lateral thermal expansion.

Adequate clearance shall be provided for every long & high temperature lines to avoid clashing at the bends. See 5.2.2 also for line spacing at 'L' bends and loops.

Expansion loops for all lines shall generally be kept at the same location.

Vents shall be provided on all high points & drains shall be provided at all low points. Drain valves at sleeper piping shall be kept outside the sleeper way if the same is not accessible and valves shall be put in horizontal only.

Places where piping is extended to make drain valves accessible - 2 nos. of stiffeners, irrespective of pipe rating, shall be provided as per 5.13.1. Spacing of guides on each line on a pipe bay shall not exceed the value given in clause 5.13.1

5.4 Flare Piping

Flare header shall be sloped towards flare knock-out drum. Only horizontal loop shall be provided as per requirement to accommodate thermal expansion. The desired slope shall be ensured throughout including flat loop. Flare header shall be supported on shoe of height ranging from 100mm to 300mm.

Proper thermal analysis temperature shall be established including the possibility of temperature gradient along the line before providing expansion loops. Efforts shall be made to minimize the number of loops. Flare line between knock out drum and water seal drum shall be designed for pressure fluctuations and adequately supported to avoid vibrations.

5.5 Underground Piping

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- 5.5.1 Underground steel piping shall be protected from electric corrosion.
- 5.5.2 Underground piping passing under loaded areas, such as main roads in the plant, shall be protected from heavy traffic by casing pipes or covers extending at least 1 m on either side of the area or having the wall thickness sufficient to bear earth pressure.
- 5.5.3 Underground piping shall be sloped to all drain points with a downward slope of not less than 1 m in 150 m.
- 5.5.4 Expansion elbows or joints of underground piping for hot fluids, such as steam or heated heavy oil, shall be enclosed in a conduit from which they are separated to allow free longitudinal expansion.
- 5.5.5 Where it is impossible to run pipe aboveground or underground, trenches may be used.
- 5.5.6 Trenches for piping close to process equipment should be avoided, whenever possible.
- 5.5.7 All underground pipe work shall be provided with following protection:
- a) At location where Underground Piping becomes above ground, INSULATING GASKET with material Glass Filled Teflon or equivalent shall be provided.
 - b) CATHODIC PROTECTION (CP) shall be provided to all underground piping. Specification shall be submitted by the CONTRACTOR & shall be approved by the OWNER.
 - c) Underground piping shall be wrapped & coated by "PYP KOTE" or equivalent tapes / sheets, 4.00 mm thick & shall be "HOLIDAY TESTED" before Hydro Test.
 - d) All underground pipes shall have Sand Bed, at least 150 MM all around the pipe.
 - e) All road crossings by Underground piping shall be through Hume Pipe Sleeves.
- 5.5.8 **Buried Pipes**
- The following points to be considered in designing of buried pipes
- i) All underground metallic piping shall be coated and wrapped and provided with cathodic protection system. If sacrificial metal is used, permanent testing arrangement shall be provided.
 - ii) All cooling water distribution headers 18" and higher shall be laid underground.
 - iii) All Sewage lines (oily and chemical) from catch basin to mains and manholes shall be laid underground.
 - iv) Underground pipe crossing roads, access ways and rails shall have casing pipe (R.C.C or C.S).
 - v) Valve chamber wherever required shall be made of brick or concrete. Valve chamber should be spacious to attend valves during operation/Maintenance.
 - vi) All U.G. headers shall clear equipment foundations as far as possible. Under special cases, the C.W. header may be laid over the footing of foundations.
 - vii) Provide break flange at + 500 MM from floor level connection with cathodic protection to isolate underground pipe from above ground piping with insulating gasket KIT.
 - viii) Pipes shall be laid below electrical cables if any.

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- ix) Top of underground piping shall be below grade level at least 1 meter deep in case of open areas and 1.5 meter deep for roads.

5.5.9 Piping in Trenches

The following points to be considered in designing of trench pipes

- i) Piping located below grade, requiring inspection, servicing or provided with protective heating.
- ii) Fire water lines/Process lines.
- iii) Drain lines requiring gravity flow trenches.
- iv) Sump for valves and trenches shall be provided.
- v) Suitable draining scheme for trenches shall be provided.

5.6 Air Systems

5.6.1 Branch connections shall be taken from the top of the header.

5.6.2 Low points shall be fitted with drains.

5.7 In-Line Instruments

5.7.1 Liquid level controllers and level glasses shall be located so as to be accessible from grade, platform or permanent ladder. The level glass shall be readable from grade wherever possible.

5.7.2 Relief valves shall be accessible. Relief valves with a centre line elevation over 4.5 M above grade (except in pipe racks) shall be accessible from a platform or permanent ladder.

5.7.3 Relief valves that discharge to a closed system shall be installed higher than the collection header, with no pockets in the discharge line.

5.7.4 Relief valves that discharge to atmosphere shall have tail-pipes extended to a minimum of 3.0 M above the nearest operating platform that is within a radius of 8 M.

5.7.5 Provide steam traps at pocketed low points and at dead ends of steam headers. Provide steam traps on excessively long runs of steam piping to ensure dry quality steam at destination. Steam traps located more than 4.5 M above grade, except in pipe racks, shall be accessible from a platform.

5.7.6 Control valves shall be accessible from grade or platforms. In general, the instruments or indicators showing the process variables shall be visible from the control valve.

5.7.7 Orifice runs shall be located in the horizontal. Orifice flanges with a centre line elevation over 4.5m above grade, except in pipe racks, shall be accessible from a platform or permanent ladder.

5.7.8 Orifice taps shall be located as follows:

- i) Air, Gas and steam
Top vertical centreline (preferred)
45 degrees above horizontal centreline (alternate)
- ii) Liquid
Horizontal centreline (preferred)
45 degrees below horizontal centreline (alternate)
- iii) Tap orientation shall be shown on piping isometrics.

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5.8 Sample Connections

Sample connections shall be accessible from grade or platforms. In general, where liquid samples are taken in a bottle, locate the sample outlet above a drain funnel to permit free running of the liquid before sampling.

5.9 Vents and Drains

5.9.1 The minimum size of vent and drain connections shall be as follows:

For process & utilities lines :

4" & Below NPS ¾"

6" & 10" NPS 1"

12" & above NPS 1 1/2"

Vent & Drain shall be provided with the valve & blind flange. For all vents / drains of process lines / utilities lines, double valves shall be required for 600 # & more rating.

Process vents and drains shall be indicated on the P&ID's

5.9.2 Vent, drain and sampling valves on process lines, not connected to a piping system, shall be provided with appropriate end closures.

5.9.3 Vents shall be located at high points of pipelines when necessary.

5.9.4 Drains shall be located at low points to empty pipelines or equipment after testing or during maintenance (i.e for every loop).

5.9.5 All drains and vents shall be provided with valve, except that vents for test purpose for flare liens (header), may be plugged. Exposed threads shall generally be seal welded.

Low-point hydrostatic drains and high-point hydrostatic vents shall be added as required; locations to be determined during the design review.

5.9.6 Vent valves shall be the globe or gate type and drain valves the gate type.

5.9.7 Valved bleeds shall be provided at control valve stations, level switches, level controllers, and gauge glasses.

5.10 Line Strainers

5.10.1 Provide temporary conical type strainers in 2" NB and above butt weld pump suction lines for use during start-up. Arrange piping to facilitate removal.

5.10.2 Provide permanent Y-type strainers for pump suction piping below 2" NB Thd or SW.

5.10.3 Provide temporary basket type strainers located at the suction pulsation device inlet for start-up of reciprocating compressors. Arrange piping to facilitate removal of the filter.

5.10.4 Provide temporary basket type strainers and locate them as close as possible to the compressor inlet flange for start-up of centrifugal compressors. Arrange piping to facilitate removal of the filter.

5.10.5 Allowable pressure drop when specified shall be certified by vendor along with the offer. If asked specifically, vendor shall furnish pressure drop calculations

5.10.6 All 2" & higher sized Y type strainers shall be provided with 3/4" threaded, tap and solid threaded plug as drain connection. For less than 2", this shall be ½ " size.

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5.10.7 Bottom flange of Y-type strainer shall not have tapped hole. Full length standard size studs shall be used for joining blind flange.

5.10.8 For fabricated strainers, all BW joints shall be fully radiographed and fillet welds shall be 100% DP/MP checked.

5.10.9 All the strainers shall be hydrostatically tested at twice the design pressure.

5.11 Spectacle Blinds

5.11.1 Spectacle blinds shall be provided to isolate equipment. In hazardous service flanged drop-out spools shall be provided for safety purposes. Both shall be shown on the P&ID's.

5.11.2 Spectacle blinds shall be accessible from grade or platforms. Blinds located in a pipe-rack are considered to be accessible. Blinds that weigh over 40kg shall be accessible by mobile equipment. Where this is not possible davits or hitching points shall be provided.

5.12 Flexibility Analysis and Supporting

5.12.1 Pipe Supporting Criteria & General Guidelines.

Piping system shall be properly supported taking into account the following points:

1. Load of bare pipe + fluid + insulation (if any).
2. Load of bare pipe + water fill.
3. Load of valves and online equipment and instrument.
4. Thermal loads during operation.
5. Steam-out condition, if applicable.
6. Wind loads for piping at higher elevation, e.g. transfer lines, column over head lines, flare headers, etc.
7. Forced vibration due to pulsating flow.
8. Vibration due to two phase flow.
9. Loads due to internal pressure.
10. Any external loads/concentrated loads and cold load of springs.

Pipe supporting shall preferably follow the minimum basic span as given in Annexure-1 except for flare line in off site on trestles in which case the maximum basic span shall be restricted to 18.0 meters, irrespective of line size.

For sizes not covered in Annexure-1, basic span shall be established based on project requirement. For piping on rack or sleeper, as a minimum, providing resting support on every grid of pipe rack / sleeper is mandatory. Depending on the pipe size, as a rule, guides shall be provided on straight run of pipes at intervals as specified in Annexure-3 unless specifically becomes non-viable due to flexibility problems.

Additional supports, guides, anchors, special supports like spring supports and sway braces shall be provided after detailed analysis of piping system to restrict the forces experienced on nozzles of critical items like pumps, compressors, turbines, exchangers, air fin coolers etc.

For lines which do not need any support otherwise but become unsupported by opening of flange, etc, during maintenance and thereby may transfer the total load on a small branch

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off, a permanent support shall be suitably provided which may be a spring support also. Bare pipes of size 14" and above on elevated structures shall be supported with pad or shoe. While bare pipes of size 6" and above, on sleepers, corrosion pads shall be provided.

Pads shall be provided for insulated pipes before welding the shoes for sizes 8" & above.

Adequate stiffening shall be provided for the following:

- a) Lines in above 600#,
- b) Lines having two phase flow,
- c) Lines having Pulsating flow such as discharge of reciprocating compressors & reciprocating pumps,

For pulsating flow lines detailed thermal and vibration analysis by analog study shall be done to decide location of anchor supports and guides etc. Pulsating flow lines shall be as identified by licensor/owner.

Wherever two phase flow in piping is expected, piping design shall be checked by dynamic analysis to prevent vibrations.

Pipe support design shall be such that deflection in piping systems due to sustained loads shall not exceed 15mm, in any case, between two adjacent supports.

As far as possible long trunnion types of supports (more than 0.5 metre) are to be avoided. In case long trunnion support is unavoidable in straight length of pipe, trunnion height to be restricted to 0.5 M and balance height to be made up by providing extended structure.

In the heaters where steam air decoking provision is there, the main lines and decoking lines should be supported in a way so that either of the lines should not be in the hanging position while connected to other one. Same philosophy shall be adopted for similar type of switch over arrangement.

Piping passing through the technology structure or passing near the concrete column etc. should have adequate annular space to avoid restriction of line movement during thermal expansion. The gap should take care the thermal expansion along with insulation thickness.

High density PUF blocks shall be considered for cold piping supports. Use of wood blocks shall be avoided.

All pipes supports shall be so designed that there is no undue tension on equipment flanges. Flange joints should not move away from each other in case of unbolting of the joint.

5.12.2 Flexibility Analysis Criteria & General Guidelines

- 5.12.2.1 Formal flexibility analysis by computer program of piping system shall be performed on latest version of CAESAR-II software as per Annexure 5, 5A & 5B.
- 5.12.2.2 The directions of forces and moments shall be in accordance with Welding Research Council Bulletin 107 (WRC 107), with the exception that the radial force (P) shall be away from the vessel. All forces and moments shall be assumed to act simultaneously and apply at the nozzle/vessel interface.
- 5.12.2.3 Air coolers to API 661 shall be specified with Fx forces and Mz moments increased to 1.2 times the value shown in Figure 8 of API 661 for nozzle sizes 6"NPS and larger to simplify piping flexibility analysis and facilitate piping layout.

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5.12.2.4 Piping stress analysis and equipment nozzle loading analysis shall be in accordance with ASME B31.3 and the relevant API, ANSI/ISO and NEMA Codes.

5.12.2.5 API 610 Pumps

The allowable nozzle loads on centrifugal pumps shall meet the load criteria of API 610. Heavy duty base plate shall be specified where the pump design temperature is in excess of 150°C.

ASME or Manufacturer's Standard Pumps

The allowable nozzle loads on horizontal centrifugal pumps design to ASME B73.1 shall be specified by the manufacturer. For preliminary layout and analysis NEMA SM 23 criteria shall be used for individual nozzles.

Other Horizontal Centrifugal Pumps

The allowable nozzle loads shall meet the load criteria specified by the manufacturer.

Vertical Turbine, Can-Types Pumps

The combined bending and tensional thermal stress in the piping attached to the nozzle shall be limited to 25 percent of the allowable stress range shown in ASME B31.3. The combined stress due to dead load and other sustained loads shall be limited to 25 percent of the allowable hot stress.

5.12.2.6 For piping design purposes, differential settlement between items of major equipment on separate foundations shall be taken as 10 mm.

5.12.2.7 Cold springing in piping shall not be permitted without written permission from the Owner. Cold springing of piping directly connected to rotating equipment is not permitted under any circumstances.

Piping shall be analyzed for expansion, contraction, differential settlement, relief, valve reaction and effects mentioned at Cl. 5.12.1.

The design of piping systems shall take into account the different conditions expected during operation, start-up, shut-down, cold branch in case of standby pump, tracing, etc. Hydrocarbon lines shall be designed for steam-out conditions, if specified in line schedule. The use of expansion joints shall be considered only when space or pressure drop limitation does not permit pipe bends. Expansion joint of axial type shall be avoided.

Forces and moments due to weight, thermal loads and other imposed loads on the equipment nozzle must not exceed the allowed loads for the equipment.

Minimum analysis temperature shall be the design temperature of the line as per line list.

5.12.3 **Method of Analysis**

Formal computer analysis shall be performed on piping systems as per design philosophy for stress analysis

The package used shall be latest version of CEASER / AUTO PIPE / SIMPLEX / CAEPIPE. Only one of these packages shall be used for the project & not a combination of the above packages.

All lines shall be analyzed at design / analysis temperature. In the absence of analysis temperature lines shall be analyzed at design temperature.

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However in case of wide difference in design and operating temperature, temperature for analysis shall be established in process documents. (e.g. flare line)

All non-critical lines may be analyzed using other methods.

Special analysis methods shall be followed for lines involving pulsating flow such as those connected to reciprocating pumps & compressors which require acoustical plus analog study by approved agencies and shall require entire system analysis along with piping / equipments.

Seismic analysis shall be done for line sizes 12" and above.

5.13 Personnel Protection

5.13.1 Eyewash and emergency safety showers shall be provided in areas where operating personnel are subject to hazardous sprays, emissions or spills.

5.13.2 Personnel protection shall be provided on un-insulated lines and equipment operating above 70 deg C when they constitute a hazard to the operators during normal operation of the facility.

5.13.3 Leakage indicating tape and spray impingement shrouds shall be provided at flanged joints in hazardous service.

5.14 Mechanical Handling

5.14.1 Handling facilities such as davits and monorails shall be provided on vessels over 10m in height where the weight of removable internal and/or external equipment is greater than 35 Kg.

6.0 MATERIALS

6.1 General

6.1.1 Basic material selection of particular line depending on its service, temperature and corrosivity shall be spelt out in process package. Material specification shall follow the requirements as per process parameters & attached PMS / VMS.

6.1.2 Only piping materials listed in ASME B31.3 shall be used for Category 'M' and Normal Service piping. Unless otherwise specified in PMS, For Category 'D' utility piping, where scaling and impurities are to be avoided (such as instrument air, potable water and deluge water) hot dipped galvanised and threaded fittings may be used in sizes up to and including 4" NB. Galvanised piping shall not be used in environments containing acids or other corrosive commodities. In corrosive environments stainless steel piping material shall be used for such utility systems.

6.1.2 All items/parts of Austenitic Stainless Steel shall be supplied in solution annealed condition.

6.1.3 In absence of specific requirement, Natural Rubber shall be used for lining in rubber lined piping items, wherever applicable. The Vendor shall confirm the suitability of Rubber Material for specified service. Unless otherwise specified, rubber lining shall be in accordance with IS4682 Part-I.

6.1.4 Unless otherwise specified, HDPE pipes & fittings shall be in accordance to ASTM D3035/ ASTM D3261/ASTM D3350 or equivalent.

6.1.5 Specification for FRP material

6.1.5.1 Anticorrosion Barrier of Polymer veil having minimum thickness 2.5 mm shall be provided for

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chemical resistance. Mechanical resistance to be sustained by FRP.

6.1.5.2 The selected nominal pipe wall thickness will include manufacturers full under tolerance, and the specified corrosion and/or erosion allowance. The pipe thickness will be adequate to resist all external loads from thermal, mechanical and other sources in addition to the process pressure-temperature requirements. However the pipe thickness will be according to vendor's norms and standard calculations but not be lower than indicated in DIN 16965 Part 4. External FRP layer shall be protected against ultra-violet light.

6.1.6 Cast Iron shall not be used as Material of Construction for any piping items like Pipes, fittings, flanges, valves, fasteners, gaskets, etc.

6.2 Pipe

6.2.1 Calculation of pipe thickness and branch reinforcement shall be based on requirements of ASME B31.3. Proper corrosion allowance and mill tolerance shall be considered to achieve the selected thickness.

6.2.2 Unless specifically exempted, welded pipes shall be acceptable only with longitudinal weld made employing automatic welding. 100% radiography for all welds except for pipes for category D service.

6.2.3 Double seam 180° apart is allowed for sizes 36" and larger only.

6.2.4 Galvanized Pipes shall be only Hot Dip galv. to ASTM A53.

6.2.5 Hydrostatic tests shall be applied to each length of pipe and be in accordance with the requirements of ASTM A530/A530M, unless otherwise specified.

6.3 Fittings

6.3.1 Type of fittings shall be equivalent to pipe type in construction.

6.3.2 Thickness of fittings at ends to match pipe thickness for BW fittings. For reducing BW fittings having different wall thicknesses at each end, the greater one shall be employed and the ends shall be matched to suit respective thickness.

6.3.3 Unless and otherwise specified in the requisition all socket weld and screwed fittings shall be in accordance with ANSI B16.11 to the extent covered in the specification except for unions which shall be in accordance with MSS-SP-83.

6.3.4 Special fittings like Weldolet, Sockolet, Sweepolet etc. which are not covered in ANSI , MSS-SP shall be as per Manufacturer's Std. Contours of these fittings shall meet the requirements of ANSI 31.3. Manufacturer shall submit drawings/catalogues of these items along with the offer & also shall be submitted for approval before manufacturing.

6.3.5 All pipes employed for manufacturing of fittings shall be required to have undergone Hydro test to ASTM A530.

6.3.6 All welded fittings shall be 100% Radio-graphed by X-Ray on all welds.

6.4 Flanges

6.4.1 All flanges shall be of forged one piece material (seamless), and plate may not be substituted without written approval from the Purchaser.

6.4.2 All flange joints on piping system including flanges on the equipment, manholes, etc shall be tightened using Torque wrench / hydraulic bolt tensioner depending upon service criticality.

6.5 Gaskets

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Gaskets shall be as per piping material specification/ applicable standard.

6.6 Stud, Bolts, Nuts and Jack Screws

6.6.1 All bolting shall be as per ASME/ANSI 818.2.1 for Studs, M/C Bolts and Jack screws, and ASME/ANSI B18.2.2 for nuts. Machine Bolts shall not be used in piping flange joint, except for Butterfly Valves, which shall be lug type, having UNC Threads in lugs facilitating opening of flanges from both sides.

6.6.2 Screw threads of bolting shall be unified coarse threads in accordance with ANSI / ASME B1.1 having Class 2A for bolts and Class2B for nuts. Screw threads in size-1/8 and larger shall be 8 threads per inch.

6.7 Valves

6.7.1 General

All flanged valves (except forged) shall have flanges integral with the valve body.

Yoke material shall be at least equal to body material.

Forgings are acceptable in place of Castings but not vice-versa.

No cast iron material valves to be used in any service.

Valves in saline water (if applicable) service shall be with non ferrous trims and all wetted parts other than trims shall be epoxy coated.

Valve body basic MOC shall be equivalent or above basic MOC of connecting pipe.

6.7.2 Ball/Plug/Butterfly Valves

Use of soft seated ball/plug/butterfly valves shall be suitably selected based on temperatures handled.

Butterfly valves shall be suitable for throttling application.

Lug type Butterfly valves shall be with threaded lugs only. Each butterfly valve shall be provided with the Bolts to be installed from both sides separately.

PN equivalent rating for Class150# valves shall be minimum PN16.

Ball valves may be used in place of gate or plug valves with the following limitations:

- i) Operating conditions are within the permissible pressure - temperature range of seat materials.
- ii) Fire safe type to be used for hydrocarbon services.

6.7.3 Valve Dimensions

Face-to-Face/End-to-End dimension shall be as per ANSI B16.10. In case the same is not covered under B16.10, the dimension shall be as per BS 2080/manufacturer standard.

Hand wheel diameter shall not exceed 750mm and lever length shall not exceed 500 mm on each side. Effort to operate shall not exceed 35 kgf at hand wheel periphery. However, failing to meet the above requirement, vendor shall offer gear operation.

Quarter-turn valves shall have "open" position indicators with limit stops.

6.7.4 Non Destructive Testing of Valves

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6.7.4.1 Radiography procedure, areas of casting to be radiographed, and the acceptance criteria shall be as per ASME/ANSI B16.34.

All valve castings shall be of radiographic quality.

The minimum requirement of radiography shall be as under:

Class	Size	Qty
150	Up to 24"	5%
150	26" & above	100%
300	Up to 16"	10%
300	18" & above	100%
600 & above	All	100%

6.7.4.2 The welds of body-to-bonnet and body-to-end flange shall be subjected to 100% NDT; both radiographic and magnetic or liquid penetrant examinations.

6.7.4.3 Beveled ends on each butt welding end valve shall be subjected 100% magnetic particle or liquid penetrant examination.

6.7.4.4 Each valve shall be pressure tested in accordance with API 598.

6.7.5 **Criteria for Isolation Valves**

Installation	Process Isolation	Drain/Vent	Pressure Taping	Level Taping	Flow Element	Safety Valve	Control Valve
150 / 300#	Single	Single	Single	Single	Single	Single	Single
600 #	Single	Single	Double	Single	Double	Single	Single
Above 600#	Double	Double	Double	Double	Double	Double	Single

Note: For S/D & at battery limit, it will be as per process requirements.

6.8 **Traps**

Vendor shall also furnish the performance curve indicating the capacity in mass/hour at various differential pressures across the trap.

Parts subject to wear and tear shall be suitably hardened. Traps shall have integral strainers.

All traps shall be hydrostatically tested to twice the design pressure.

6.9 **Hoses**

Manufacturer shall guarantee suitability of hoses for the service and working conditions specified in the requisition, if the material is not specified in the Material Requisition for any particular service.

All hoses shall be marked with service and working pressure at minimum two ends clearly.

Hoses shall be resistant to ageing, abrasion and suitable for outdoor installations.

Complete Hose assembly shall be tested at two times the design pressure

Steam hoses shall be subject to steam resistance test.

6.10 **Expansion Joints (Metallic)**

The applicable codes are ASME B31.3 and EJMA (Expansion Joint Manufacturer's Association).

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Bellows shall be formed from solution annealed sheet conforming to the latest ASTM Spec. Any longitudinal weld shall be 100% radiographed. The finished longitudinal weld must be of the same thickness and same surface finish as the parent material.

Circumferential welds are not permitted. Bellows are to be hydraulically or expansion (punched) formed. Rolled formed bellows are not acceptable. Noticeable punch or die marks resulting from expansion operation are not acceptable.

No repairs of any kind are allowed on the bellows after forming. Deep scratches and dents are not acceptable.

The out of roundness shall be limited to ± 3 mm. This is the max deviation between the max & min diameter.

The actual circumference of the welding end shall be maintained to ± 3 mm of the theoretical circumference.

Apart from the usual requirements, the vendor shall also furnish

- a) Design calculations to justify stiffness and fatigue life.
- b) Axial, lateral stiffness, angular stiffness, effective pressure thrust area.
- c) Installation/maintenance manual.

6.11 **Supports & Spring Assemblies**

The Material, Design, Manufacture and Fabrication shall be generally as per MSS-SP-58/ MSS-SP-89 and/or BS 3974.

Testing of springs shall be as per BS1726.

6.12 **Non Destructive Examination**

10% radiography of butt welds and 10%DP/ MP test of fillet welds shall be done for pipe Classes in 150# & 300#.

100% radiography on butt weld joints and 100% DP/MP for fillet welds test shall be done for Pipe Classes in 600# & above.

7.0 **PAINTING**

Painting shall be as per attachment provided elsewhere in NIT.

8.0 **WELDING**

Welding shall be as per ASME BPV- Sec. IX

ANNEXURE – 1

TABLE OF BASIC SPAN

Pipe Size In.	SCH/Thickness (in)	PIPE- VAPOR INSULATION			PIPE- LIQUID INSULATION			BARE PIPE EMPTY		BARE PIPE WATER FILLED		Pipe size in.
		BASIC SPAN (L)M			BASIC SPAN (L)M			SPAN(L) M	WEIGHT KG/M	SPAN(L) M	WEIGHT KG/M	
		UPTO 175 ^o C	176 ^o C TO 315 ^o C	316 ^o C TO 400 ^o C	UPTO 175 ^o C	176 ^o C TO 315 ^o C	316 ^o C TO 400 ^o C					
3/4"	SCH 40	3.5	3.5	2.5	3.5	3.0	2.0	4.5	1.68	4.0	2.04	3/4"
1"	SCH 40	4.5	4.0	3.0	4.5	3.5	3.0	5.0	2.52	4.5	3.07	1"
1-1/2"	SCH 40	5.0	5.0	4.5	5.0	4.5	3.5	6.0	4.08	5.0	5.4	1-1/2"
2"	SCH 40	5.5	5.0	4.5	5.0	4.5	3.5	8.5	5.47	5.5	7.65	2"
2-1/2"	SCH 40	6.5	6.0	5.0	6.0	5.5	4.5	7.5	8.7	6.5	11.79	2-1/2"
3"	SCH 40	7.5	6.5	5.5	6.5	6.0	5.0	8.0	11.35	6.5	16.15	3"
4"	SCH 40	8.0	7.5	6.5	7.5	7.0	6.0	9.0	16.2	7.5	24.45	4"
6"	SCH 40	10.0	9.5	8.5	9.0	8.0	7.5	10.5	28.3	9.0	46.7	6"
8"	SCH 40	12.0	11.0	10.0	10.0	10.0	9.0	12.0	42.84	10.0	75.22	8"
10"	SCH 40	13.5	13.0	12.0	11.5	10.5	10.5	14.0	60.74	11.5	111.9	10"
12"	3/8" w	14.5	13.5	13.0	12.0	11.5	11.0	15.0	74.40	12.0	147.5	12"
14"	3/8" w	15.0	14.5	13.5	12.0	12.0	11.5	16.0	82.5	12.5	172.05	14"
16"	3/8" w	16.0	15.5	14.5	13.0	12.5	12.0	17.0	94.5	13.0	213.15	16"
18"	3/8" w	17.0	16.5	15.0	13.5	13.0	12.0	18.0	106.5	13.5	258.3	18"
20"	3/8" w	18.0	17.5	16.0	14.0	13.5	12.5	19.0	118.5	14.0	307.5	20"
24"	3/8" w	20.0	19.0	17.5	14.5	14.5	13.0	21.0	142.5	15.0	418.2	24"
3/4"	SCH 80	3.5	3.5	2.5	3.5	3.0	2.0	4.5	2.20	4.0	2.49	3/4"
1"	SCH 80	4.5	4.0	3.0	4.5	3.5	3.0	5.0	3.25	4.5	3.72	1"
1-1/2"	SCH 80	5.0	5.0	4.5	5.0	4.5	4.0	6.0	5.45	5.0	6.60	1-1/2"
2"	SCH 80	6.0	5.0	4.5	5.5	5.0	4.0	6.5	7.53	6.0	9.45	2"
2-1/2"	SCH 80	6.5	6.0	5.5	6.0	6.0	5.0	7.5	11.49	6.5	14.25	2-1/2"
3"	SCH 80	7.5	6.5	6.0	6.5	6.5	6.0	8.0	15.37	7.0	19.66	3"
4"	SCH 80	8.0	8.0	7.0	7.5	7.5	6.5	9.0	22.47	8.0	29.94	4"
6"	SCH 80	10.5	10.0	9.0	9.5	9.0	8.5	10.5	42.90	9.5	59.85	6"
8"	1/2" w	12.0	11.5	10.5	10.5	10.0	10.0	12.0	65.10	11.0	94.8	8"
10"	1/2" w	13.5	13.0	12.0	11.5	11.5	10.5	14.0	82.20	12.0	130.69	10"
12"	1/2" w	14.5	13.5	13.0	12.5	12.0	11.5	15.0	98.13	13.0	168.64	12"
14"	1/2" w	15.0	14.5	13.5	13.0	12.5	12.0	16.0	108.15	13.5	194.4	14"
16"	1/2" w	16.0	15.5	15.0	13.5	13.0	13.0	17.0	124.2	14.0	240.0	16"
18"	1/2" w	17.5	17.0	16.0	14.5	14.0	13.5	18.0	140.25	14.5	286.64	18"



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Pipe Size In.	SCH/Thickness (in)	PIPE- VAPOR INSULATION			PIPE- LIQUID INSULATION			BARE PIPE EMPTY		BARE PIPE WATER FILLED		Pipe size in.
		BASIC SPAN (L)M			BASIC SPAN (L)M			SPAN(L) M	WEIGHT KG/M	SPAN(L) M	WEIGHT KG/M	
		UPTO 175 ⁰ C	176 ⁰ C TO 315 ⁰ C	316 ⁰ C TO 400 ⁰ C	UPTO 175 ⁰ C	176 ⁰ C TO 315 ⁰ C	316 ⁰ C TO 400 ⁰ C					
20"	½" w	18.0	17.5	17.0	15.0	14.5	14.0	19.0	157.5	15.0	341.8	20"
24"	½" w	20.0	19.0	18.5	16.0	15.0	15.0	21.0	188.25	16.0	458.44	24"
1"	10S	4.0	3.5	3.0	4.0	3.0	2.5	4.5	2.08	4.0	2.7	1"
1-112"	10S	5.0	4.5	3.5	4.5	4.0	3.0	5.5	3.12	5.0	4.57	1-112"
2"	10S	5.0	4.5	3.5	4.5	4.0	3.0	6.0	3.94	5.5	6.33	2"
2-112"	10S	6.5	5.5	4.5	5.5	5.0	4.5	7.0	5.26	6.0	8.85	2-112"
3"	10S	7.0	6.0	5.0	6.0	5.5	5.0	7.5	6.45	6.0	11.91	3"
4"	10S	7.5	7.0	6.0	6.0	6.0	6.0	8.0	8.34	7.0	17.87	4"
6"	10S	9.5	9.0	8.0	8.0	7.5	7.5	10.0	13.82	8.5	34.54	6"
8"	10S	11.0	10.5	10.0	9.5	9.5	8.5	11.5	19.94	10.0	55.5	8"
10"	10S	12.5	12.0	11.0	10.5	10.0	9.5	13.0	27.53	11.0	83.4	10"
12"	10S	14.0	13.0	12.0	11.0	11.0	10.0	14.5	36.00	11.5	114.6	12"
14"	10S	14.5	14.0	13.0	11.5	11.0	11.0	15.5	41.18	11.5	132.6	14"
16"	10S	16.5	14.5	14.0	12.0	11.5	11.5	16.5	47.33	12.5	172.2	16"
18"	10 S	16.5	15.5	14.5	12.5	12.5	11.5	17.5	53.18	13.0	212.1	18"
20"	10 S	17.5	16.5	15.5	13.0	13.0	12.0	18.5	68.50	13.0	264.5	20"
24"	10 S	19.0	18.0	17.0	14.0	13.5	12.5	20.5	94.37	14.0	376.8	24"

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ANNEXURE – 2

ACCESSIBILITY FOR VALVES AND INSTRUMENTS

VALVES, INSTRUMENTS, EQUIPMENT TO BE OPERATED	CENTRELINE OF ITEM TO BE OPERATED, LOCATED LESS THAN 3.6m ABOVE GRADE, 2.75 m ABOVE FLOOR OR PLATFORM OR 1.8m ABOVE WING PLATFORM	CENTRELINE OF ITEM TO BE OPERATED, LOCATED MORE THAN 3.6m ABOVE GRADE, 2.75m ABOVE FLOOR OR PLATFORM OR 1.8m ABOVE WING PLATFORM
EXCHANGER HEADS	NIL	PLATFORM
OPER. VALVES 2" & SMALLER	FIXED LADDER	FIXED LADDER
OPER. VALVES 3" & ABOVE	PLATFORM	PLATFORM
MOTOR OPERATED VALVES	PLATFORM	PLATFORM
CONTROL VALVES	PLATFORM	PLATFORM
RELIEF VALVES 2" & SMALLER	FIXED LADDER	FIXED LADDER
RELIEF VALVES 3" & ABOVE	PLATFORM	PLATFORM
BLOCK VALVES 2" & SMALLER	PORTABLE LADDER	PLATFORM
BLOCK VALVES 3" & ABOVE	PLATFORM (NOTE-1)	PLATFORM (NOTE-1)
BATTERY LIMIT VALVES	PLATFORM	PLATFORM
PRESSURE INSTRUMENT	FIXED LADDER IF ABOVE 2.2m HEIGHT	FIXED LADDER
TEMPERATURE INSTRUMENT	FIXED LADDER IF ABOVE 2.2 M Ht	FIXED LADDER
SAMPLE POINTS	PLATFORM	PLATFORM
GAUGE GLASSES	FIXED LADDER	FIXED LADDER
LEVEL CONTROLLERS	PLATFORM	PLATFORM
PROCESS BLINDS AND SPACERS 2" & SMALLER	PORTABLE LADDER / PLATFORM	PLATFORM
PROCESS BLINDS AND SPACERS 3" & ABOVE	PLATFORM	PLATFORM
MANWAYS/MANHOLES	PLATFORM	PLATFORM
HANDHOLES/INSPECTION HOLES	PLATFORM	PLATFORM
NOZZLES (process}	PLATFORM	PLATFORM
VESSEL VENTS	PORTABLE LADDER	FIXED LADDER
LINE DRAINS & VENTS	PORTABLE LADDER	PORTABLE LADDER
ORIFICE FLANGES	PLATFORM (NOTE-1)	PLATFORM (NOTE-1)

NOTE -1:-BLOCK VALVES / ORIFICE FLANGES, IF LOCATED, WITH CENTRE LINES GREATER THAN 2 METER FROM THE OPERATING FLOOR / OPERATING PLATFORM, SHALL BE PROVIDED WITH PORTABLE PLATFORM OR CHAIN FOR OPERATION.

NOTE -2 : PLATFORM SHALL BE PROVIDED FOR THE ORIFICE FLANGES ON PIPE RACK.

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ANNEXURE-3

MAXIMUM SPACING OF GUIDES FOR VERTICAL & HORIZONTAL PIPES

NOM PIPE SIZE IN INCHES	VERTICAL SPACING METRES	HORIZONTAL SPACING METRES
1	6.0	6.0
1 ½	6.0	6.0
2	6.0	6.0
3	8.0	12.0
4	8.0	12.0
6	8.0	12.0
8	8.0	12.0
10	12.0	18.0
12	12.0	18.0
14	12.0	18.0
16	12.0	18.0
18	12.0	18.0
20	16.0	18.0
24	16.0	18.0
26 & ABOVE	16.0	18.0

NOTES:-

1. These spacings may be varied to suit column spacing of rack. The above spacing is for straight runs of pipe & does not include guides which are used for control of thermal movements, as decided by stress group.
2. The guide spacings given in the above table are indicative only.

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ANNEXURE – 4

CLEARANCES

Minimum clearances for piping, equipment, structures, platforms, and supports shall be in accordance with the following table:

Item	Description	
Roads	Headroom for primary access roads wherever heavy duty crane movement is required.	9 M
	Headroom for primary access roads	7.5 M
	Width of primary access roads excluding shoulders.	Refer Civil
	Headroom for secondary roads	5 M
	Width of secondary roads excluding shoulders.	Refer Civil
	Clearance from edge of road shoulders to platforms, equipment, pipe associated with equipment, or similar features.	1.5 M**
Maintenance Aisles at Grade	Horizontal clearances for equipment maintenance by hydraulic crane (12t capacity)	3 M
	Vertical clearance for equipment maintenance by hydraulic crane (12t capacity)	3.6 M
	Horizontal clearance for fork lift and similar equipment (2500 kgs capacity)	2.4 M
	Vertical clearance for fork lift and similar equipment (2500 kgs capacity)	2.4 M
	Horizontal clearances for equipment maintenance by portable manual equipment (A-frames, hand trucks, dollies or similar equipment)	1 M
	Vertical clearances for equipment maintenance by portable manual equipment (A-frames, hand trucks, dollies or similar equipment)	2.4 M
Walkways	Horizontal clearance (not necessarily in a straight line)	750 mm
	Headroom (except for hand wheels)	2.2 M
Platforms	Minimum width	1200mm
	Headroom from stairwell treads.	2.2 M

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Item	Description	
Platforms	Minimum clearance around any obstruction on the platform.	500 mm
	Headroom	2.2 M
	Maximum vertical distance between platforms	6 M
	Minimum toe clearance behind a ladder.	210 mm
	Minimum handrail clearance.	100 mm
Equipment	Minimum maintenance space required between flanges of exchangers or other equipment arranged in pairs.	500 mm
	Minimum maintenance space required for structural members or pipe.	300 mm
	Clearance from edge of road shoulder (the extreme projection)	1.5 M
Fired Equipment	Horizontal clearance from hydrocarbon equipment (shell to shell)	15 M
	Exception: Reactors or equipment in alloy systems shall be located for the most economical piping arrangement.	
	Clearance from edge of road to heater shell.	3 M
Valve Hand wheels	Clearance between the outside of the hand wheel and any obstruction.	25 mm*
Pipe (aboveground)	Clearance between the outside diameter of the flange and the outside diameter of pipe insulation.	25 mm*
	Clearance between the outside diameter of the pipe, flange or insulation and a structural member.	50 mm*
	Clearance between the outside diameter of the flange and the outside diameter of bare pipe.	25 mm*
	Minimum distance from underside of pipe to grade or platform.	300 mm
Control Valve Arrangement	Centreline of control valve above grade or platform.	450 mm
	Minimum centreline of control valve from face of column or wall.	600 mm
	Where process conditions require steam or hydrocarbon vapours to be discharged to atmosphere at a safe location,	

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Item	Description	
	the tail pipe shall terminate as below:	
	Distance above nearest operating platform.	3 M
	Within radius of nearest operating platform.	7.5 M
** Verify conformance with local regulations. * With full consideration of thermal movements		

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ANNEXURE – 5

DESIGN PHILOSOPHY FOR STRESS ANALYSIS

1.0 PURPOSE

This design basis deals with the subject of Identification of Stress Critical pipelines and preparation of Critical line list. This procedure also defines the minimum requirements for performing stress analysis, design and location of spring, support and level of system

Analysis with the extent of documentation required for flexibility analysis.

Purpose of piping stress analysis is to ensure:

Safety of piping and piping components

Safety of connected equipment and supporting structure

Piping deflections are within the limits

2.0 SCOPE

This specification covers the supply of engineering services to perform a complete piping and pipe support analysis for piping systems.

3.0 DEFINITIONS

3.1 Critical Lines / Critical Line List

Critical lines or Critical Line List as referred to in this procedure relates to Piping Stress Critical Lines and does not include or refer to process critical lines.

3.2 Stress Analysis Temperature

Stress Analysis Temperature refers to either “Maximum Operating Temperature” or “Steam-out temperature / hot nitrogen purging temperature” of the lines under review whichever is higher. In absence of the above values, it refers to the Design Temperature of the line under review. The Line List should be strictly followed in obtaining the above temperature values.

3.3 Design Pressure

Design Pressure refers to the “Design Pressure” of the line under review as indicated on the Line List. Design Pressure is as defined in clause 301.2 of ASME B 31.3.

3.4 Temperature for Flexibility Analysis

The temperature to be used for the flexibility analysis shall be taken as the maximum / minimum temperature which the pipe will see under any combination of different normal / abnormal operating conditions, as defined in clause 301.3 of ASME B 31.3. Where piping is exposed to direct sunlight, solar radiation temperature of 70 °C is considered in establishing the maximum temperature of piping. Even, for non-critical piping exposed to direct sunlight on pipe rack or elsewhere, expansion loops, wherever essential, are provided to take care of pipe movements resulting from piping skin temperature due to solar radiation.

In general, unless there is a difference of more than 50 °C between working Temperature and the design temperature, the design temperature should be taken as Flexibility temperature. Ambient Temperature shall be considered as 21°C the assumed piping installation temperature. The displacement stress range from this installation temperature to the minimum recorded ambient temperature of 0° C being less than the same from installation temperature

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to the maximum operating temperature of hot piping in most cases, the later governs as per clause 319.2.3 of ASME B 31.3

The temperature under fire condition is normally not considered for flexibility analysis.

1.0 SELECTION

A line is selected and listed as a Critical Line provided it falls under any one of the categories defined below and is intended to include the special requirements of Piping Stress Engineer. It is hence defined as any line for which a flexibility review is required or where pipe supporting is deemed to be critical and needs review by a Stress Engineer. Line DN 50 and smaller is inherently flexible and is not normally considered critical unless built from non-metallic or non-ferrous materials. In case of more than one applicable line size, larger line size governs. Lines are classified as Level I, Level II & Level III according to the criteria listed below.

4.1 Level I [Extensive Analysis]

Piping systems or lines that meet Annexure 5A criteria are deemed to be extremely critical. These lines are categorized as Level I and require careful study to ensure that the code compliance is met and the accurate determination of nozzle and support loads have been made. The routing of these lines is very important. They must be analyzed in the early stages of the project during routing studies so that the impact on the location of less critical lines is minimized. Normally, these systems require computer analysis. The general intent of the Level I analysis criteria is to study lines size DN 80 & larger that are affected by thermal expansion and / or a dynamic response, and that can't be evaluated by a weight-only analysis (as per the general intent of Level II analysis). Consideration has to be given to other special situations that augment the Level I general intent guidelines such as for lines that are excessively large and stiff.

4.2 Level II [Normal Analysis]

Piping systems or lines that meet Annexure 5B criteria are moderately critical lines and often do not require such rigorous study to ensure code compliance or accurate determination of nozzle and support loads. These lines are smaller in size and operate at lower temperatures (in general) than the lines to be analyzed using Level I Criteria. Normally, only manual calculations, by use of appropriate monographs are required for analysis of these systems.

4.3 Level III [Minimum Analysis]

All lines that are outside the purview of Level I or Level II criteria will be classified as level III and shall be reviewed by the Piping Engineer during the squad check of the piping drawings and or fabrication Iso's. If more detailed analysis is required, the Piping Engineer may change the level of analysis during the squad check as applicable. Normally, only visual analysis is required for these systems.

4.4 Lines Deemed To Be Support Critical

Lines subjected to two-phase flow.

Cross country pipelines.

Lines with pipe thickness Sch 160 or greater.

Lines DN 400 and above with pipe thickness less than 8 mm.

Lines DN 250 and above with corrosion allowance 3 mm and above.

Lines with high concentrated loads such as heavy valves or fittings etc.

Lines downstream of Relief Valve / letdown Control Valves / bursting (rupture) discs.

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Connecting to vent or flare systems or discharging to atmosphere

Liquid Blow down Lines.

Lined pipes

Non-metallic pipes

4.5 Lines Needing Dynamic Analysis

There are instances where in the frequency of the applied load is comparable to the natural frequency of the piping system. Such systems tend to store the energy and release it according to certain scientific laws. Such a system is dynamic in nature and the study of the response of such a system is referred to as “Dynamic Analysis”. Examples of such kind of systems are Relief Valve discharge lines, water hammer and surge in pipe lines, two phase flow in pipelines, reciprocating pumps and compressor piping, submarine piping etc.

4.6 Special Piping

Special piping forming part of reformer tubes, heater internal piping, etc. are treated as proprietary piping and nozzle loading at the Interface connections are to be co-ordinate with vendor.

5.0 RELATED DOCUMENTATION

5.1 Critical Line List Format.

The critical line list shall be prepared from the project line list document by inserting following relevant fields such as Stress level, stress package no., stress analysis temperature, support critical nature of the line, dynamic loadings, steam out / purge temperature etc.

The list shall reflect analysis status of line that includes its input received date from design & output handover date to design and specific remark if any.

5.2 Lines Affecting the Flexibility of Critical Lines

Non-critical Lines found to affect the flexibility of critical lines which have not been included during the initial review are subsequently added to the Critical Line List.

Non-critical Lines on which advice may be sought by the Lead Piping Engineer are not normally entered into the Critical Line List but covered verbally, or by a memorandum if a record is required.

6.0 PIPE STRESS ANALYSIS AND SUPPORTING

6.1 Piping system shall be properly supported taking in to account of the following points:

Piping stress analysis shall follow ASME B 31.3 and shall be complete to prevent overstressing of the pipe during operating conditions with wind and seismic loadings. During sustained, occasional (wind and seismic) & thermal expansion loading on piping,

The material allowable stresses shall be as per ASME B 31.3 for ASTM materials. For DIN material specifications the allowable stress values shall be calculated as per ASME

B 31.3 clause 302.3.2(d), wherein yield strength and ultimate strength values at temperature shall be taken from DIN material standards. For DIN material specifications, the other material properties viz. elastic modulus, density, coefficient of thermal expansion shall be taken from the respective DIN material standards.

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6.2 Analysis shall include, but not be limited to the following; thermal, dead weight, internal pressure, wind and seismic, and a combination of these based on ASME B 31.3.

6.3 Piping shall be designed in accordance with the Indian Standard criteria for earthquake resistance design for structures IS: 1893 for seismic zone-IV (refer project design basis). As a minimum, two (2) orthogonal horizontal components and a vertical component of ground motion will be considered in the seismic analysis. For American standard, loading applied to piping would be in accordance with uniform building code (UBC).

The equivalent horizontal static force method shall apply in general. The contractor shall also carry out special designs and provisions as necessary for piping which is considered to be dynamically sensitive to earthquake.

Seismic analysis to be performed for lines equal to and above 12". Seismic load case shall ALGEBRIC combination with operating cases.

Heavy rigid masses like valves shall be restrained in their vicinity to avoid large seismic movements. Guides or snubbers as the case may be used for this purpose.

Horizontal seismic coefficient (A_h) to be considered as 0.26 and Vertical (A_v) to be considered as 0.173.

6.4 Wind loads shall be calculated in accordance with IS-875 code of practice for structural safety of building – Loading Standards for Indian code requirement using basic wind speed as mentioned in project design basis. For American standard, wind load in accordance to ASCE 07 shall be calculated. Reduction in velocity pressure due to apparent shielding afforded by buildings and structure or terrain shall not be permitted.

Wind loading shall only be considered for lines larger than 20" OD at elevation higher than 10m above grade. Displacements due to wind and earthquake should be limited to 50 mm.

Both the horizontal directions shall be analyzed independently in two cases

+X, -X, +Z, -Z

Wind and seismic loading will not occur simultaneously.

6.5 Analysis of all nozzles loading on vessels within the piping boundaries is covered in this specification. Nozzle analysis shall follow the guidelines of ASME Section VIII, Division 1, and WRC 297 & 107 (latest editions). Nozzle stresses shall fall within the allowable per ASME.

6.6 Piping system shall have sufficient flexibility to avoid leakage at joints. Flanged joints imposed by external moments may be analyzed and the stresses evaluated by using the methods of equivalent pressure given in the ASME boiler and pressure code section III. Flange leakage shall be assessed as per "Pressure Equivalent Method". In case of Failure in Pressure Equivalent Method, the Flanges shall be checked for leakage using Caesar Flange leakage Module. Flange leakage shall be assessed for all PSV flanges, Control valve flanges, High Pressure lines, all steam lines and also for equipment flanges where loads are high.

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- 6.7 All forces on connections to equipment shall not exceed maximum allowable as specified by equipment vendor.
- 6.8 Pipe supports loads shall be based on the maximum loads determined by the piping analysis. Adjustments shall be made to the piping system and model such that the pipe supports loads are within a reasonable uniformity throughout the piping system.
- 6.9 Various Load cases built in Caesar II to check stress in piping system are listed below.

1	WW+HP	HYD	
2	W+T1+P1	OPE	
3	W+T2+P1	OPE	
4	W+T1+P1+U1	OPE	
5	W+T1+P1+U2	OPE	
6	W+T1+P1+U3	OPE	
7	W+T1+P1-U1	OPE	
8	W+T1+P1-U2	OPE	
9	W+T1+P1-U3	OPE	
10	W+T1+P1+WIN1	OPE	
11	W+T1+P1+WIN2	OPE	
12	W+P1	SUS	
13	W+P2	SUS	
14	L2-L12	EXP	
15	L3-L12	EXP	
16	L4-L2	OCC	
17	L5-L2	OCC	
18	L6-L2	OCC	
19	L7-L2	OCC	
20	L8-L2	OCC	
21	L9-L2	OCC	
22	L10-L2	OCC	
23	L11-L2	OCC	
24	L12+L16	OCC	
25	L12+L17	OCC	
26	L12+L18	OCC	
27	L12+L19	OCC	
28	L12+L20	OCC	
29	L12+21	OCC	
30	L12+L22	OCC	
31	L12+L23	OCC	

P1- Maximum Operating Pressure W- Dead Weight

T1- Maximum Operating Temperature WW- Water Weight

P2- Design Pressure WIN- Wind Load

T2- Design Temperature U- Uniform Load

HP- Hydro test Pressure L2- Load case

SUS, EXP, OCC, HYD, OPE- Various load types, viz., sustained, occasional, hydro test, operating etc.

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7.0 CODES AND STANDARDS

The following codes and standards shall apply in the design and analysis of the piping systems covered under this specification:

Allowable Stress ASME B 31.3

Piping ASME B 31.3

Nozzle Loadings PMC's Standard, WRC297/107(Welding Research Council) /

Allowable Vendor

Wind Analysis ASCE 7 – 98

8.0 SOFTWARE USED

The package used shall be latest version of CEASER-II 5.2. Only one of these packages shall be used for the project & not a combination of the above packages.

9.0 DOCUMENT REQUIREMENT

9.1 A written report shall be submitted on the piping and equipment analysis. The report shall include all pertinent information that shall include but not be limited to the following.

Location and type of pipe supports with loads and movements.

Location of expansion joints and movements.

Vertical and horizontal loads including moments at all support points.

Vertical and horizontal loads including moments on all equipment and

Vessel connections.

Caesar II analysis report, which shall include as a minimum, restraint forces, movements and stresses for all load cases. For flange connection, loaded with high bending moments and/or tensile forces in piping or at equipment connections, Caesar II flange leakage report will be provided. For piping analyzed, if subjected to hydro test, hydro test load case will be made in Caesar II to check for loading under hydro test & the requirement of any additional temporary supports for hydro test.

Detailed nodal model used for the stress analysis

All assumptions and limitations applied to the analysis

9.2 All dimensions and analysis shall be performed using metric and SI units.

9.3 The final report / stress package folder shall be submitted as follows:

1. Front sheet with Approval status
2. Isometrics with following information
 - Node numbers
 - Type of supports selected by stress engineer
 - Springs / Bellows data required for procurement like spring rate, loads, tide/untied information and SM (special material) identification.
 - Maximum Expansion and sustain stress values with node number
 - Nozzle/Anchors initial movements and piping imposed forces and moments on the same
 - Support loads (anchors, guides or rest) only they are above limit (The limit is defined in

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- the beginning of the project in consultation with civil)
- Design and maximum operating conditions
 - Coordinate axis system considered for inputs
 - Dimensional details for piping designer to locate supports in piping model/layout.
3. Checklist as per Work instructions.
 4. Following outputs
 - Load Cases
 - Restraint summary
 - Spring hanger report, if any
 5. Stress critical line list extract for the lines analysed
 6. Piping material specifications
 7. Equipment drawings with allowable loads, if available
 8. PID

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ANNEXURE-5A

CRITERIA FOR IDENTIFYING EXTREMELY CRITICAL LINES (LEVEL I)

Temperature T, Degree C	Pipe Diameter DN (mm)	Piping Material	Service and Description
All	All	All	Piping which will undergo hydraulic shock, auto-ignition or is in service.
All	DN \geq 80	All	Category M (Lethal) fluid service per ASME B31.3 (No cyclic service).
All	DN \geq 80	All	Piping which is openly exposed to winds > 75 mph.
T < -29	DN \geq 80	Carbon Steel	All Services.
T < -45	DN \geq 80	All	All Services
T \geq 65	DN \geq 80	Non-Metallic	All Services
T \geq 65	DN \geq 80	All	Lines with pressure \geq 900 psig.
T \geq 150	DN \geq 80	All	All Services
ALL	DN \geq 400	All	All Services.
T \geq 260	ALL	ALL	ALL Services.
-29 \geq T \geq 65 OR -7 \geq T \geq 50	DN \geq 80 DN \geq 100	All	Piping connected to nozzle load sensitive equipment, air-cooled exchangers and rotating equipment (see note 1).
ALL	ALL	All	Lines requiring expansion joints or flexible connectors.
DELTA T \geq 27 (NOTE 2)	DN \geq 80	All	Jacketed piping.
-29 \geq T \geq 65	DN \geq 100	All	Internally lined pipe (except glass).
All	ALL	All	Glass lined piping.
All	DN \geq 80	All	Differential Tank Settlement (Upto 3 supports from nozzle).
-40 \geq T \geq 80 -29 \geq T \geq 70	DN \geq 100 DN \geq 200	Metallic Metallic	Underground Piping

NOTES:

- 1) Load sensitive equipment include fired heaters, reformers, lined vessels with lining of brittle material, non-ferrous equipments, graphite heat exchangers, plate & frame heat exchangers, etc.
- 2) This criterion is not to be applied to auxiliary piping such as seal flush; bearing cooling, etc. delta T refers to the differential temperature between the process piping and jacket.

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ANNEXURE-5B

CRITERIA FOR IDENTIFYING MODERATELY CRITICAL LINES (LEVEL II)

Temperature T, Degree C	Pipe Diameter DN (mm)	Piping Material	Service and Description
All	DN<80	All	Lethal fluid service.
T<-29	DN<80	Carbon Steel	All Services.
T<-46	DN<80	All	All Services
95<T<150	80<DN<200	All	All Services
T≥65	DN<80	Non-Metallic	All Services
T≥65	DN<80	All	All Services
T≥65	DN<80	All	Lines with pressure≥900 psig.
T≥150	DN<80	All	All Services
ALL	200<DN<400	All	All Services.
T≥260	ALL	ALL	ALL Services.
ALL	ALL	ALL	Piping connected to nozzle load sensitive equipment, air-cooled exchangers and rotating equipment (see note 1 of Table-1).
DELTA≥27(NOTE 2 of Table-1)	DN<80	All	Jacketed piping.
All	ALL	All	Internally lined pipe (except glass).
All	DN<80	All	Differential Tank Settlement (Upto 3 supports from nozzle).
All	ALL	All	Underground Piping
All	ALL	All	Piping connected to pressure relief
All	ALL	All	Close coupled interconnecting piping between equipment with differential movement greater than 6.0mm.



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ANNEXURE-5C

MINIMUM ALLOWABLE NOZZLE LOADINGS- VESSELS AND S/T HEAT EXCHANGERS

NOZZ. SIZE	FLANGE RATING	NOZZLE FORCES (N)				NOZZLE MOMENTS (Nm)			
		FL	FA	FC	F	MT	ML	MC	M
1.5	150#	2250	2250	1688	2385	253	219	169	238
1.5	300#	2250	2250	1688	2385	253	219	169	238
1.5	600#	3750	3750	2813	3975	422	366	281	397
1.5	900#	4500	4500	3375	4770	506	438	338	476
1.5	1500#	6000	6000	4500	6360	675	585	450	635
2	150#	3000	3000	2250	3180	450	390	300	423
2	300#	3000	3000	2250	3180	450	390	300	423
2	600#	5000	5000	3750	5300	750	650	500	705
2	900#	6000	6000	4500	6360	900	780	600	846
2	1500#	8000	8000	6000	8480	1200	1040	800	1128
3	150#	4500	4500	3375	4770	1013	878	675	952
3	300#	4500	4500	3375	4770	1013	878	675	952
3	600#	7500	7500	5625	7950	1688	1463	1125	1586
3	900#	9000	9000	6750	9540	2025	1755	1350	1904
3	1500#	12000	12000	9000	12720	2700	2340	1800	2538
4	150#	6000	6000	4500	6360	1800	1560	1200	1692
4	300#	6000	6000	4500	6360	1800	1560	1200	1692
4	600#	10000	10000	7500	10600	3000	2600	2000	2820
4	900#	12000	12000	9000	12720	3600	3120	2400	3384
4	1500#	16000	16000	12000	16960	4800	4160	3200	4512
6	150#	9000	9000	6750	9540	4050	3510	2700	3807
6	300#	9000	9000	6750	9540	4050	3510	2700	3807
6	600#	15000	15000	11250	15900	6750	5850	4500	6345
6	900#	18000	18000	13500	19080	8100	7020	5400	7614
6	1500#	24000	24000	18000	25440	10800	9360	7200	10152
8	150#	12000	12000	9000	12720	7200	6240	4800	6768
8	300#	12000	12000	9000	12720	7200	6240	4800	6768
8	600#	20000	20000	15000	21200	12000	10400	8000	11280
8	900#	24000	24000	18000	25440	14400	12480	9600	13536
8	1500#	32000	32000	24000	33920	19200	16640	12800	18048
10	150#	15000	15000	11250	15900	11250	9750	7500	10575
10	300#	15000	15000	11250	15900	11250	9750	7500	10575
10	600#	25000	25000	18750	26500	18750	16250	12500	17625
10	900#	30000	30000	22500	31800	22500	19500	15000	21150
10	1500#	40000	40000	30000	42400	30000	26000	20000	28200
12	150#	18000	18000	13500	19080	16200	14040	10800	15228
12	300#	18000	18000	13500	19080	16200	14040	10800	15228
12	600#	30000	30000	22500	31800	27000	23400	18000	25380
12	900#	36000	36000	27000	38160	32400	28080	21600	30456
12	1500#	48000	48000	36000	50880	43200	37440	28800	40608
14	150#	21000	21000	15750	22260	22050	19110	14700	20727
14	300#	21000	21000	15750	22260	22050	19110	14700	20727
14	600#	35000	35000	26250	37100	36750	31850	24500	34545
14	900#	42000	42000	31500	44520	44100	38220	29400	41454
14	1500#	56000	56000	42000	59360	58800	50960	39200	55272



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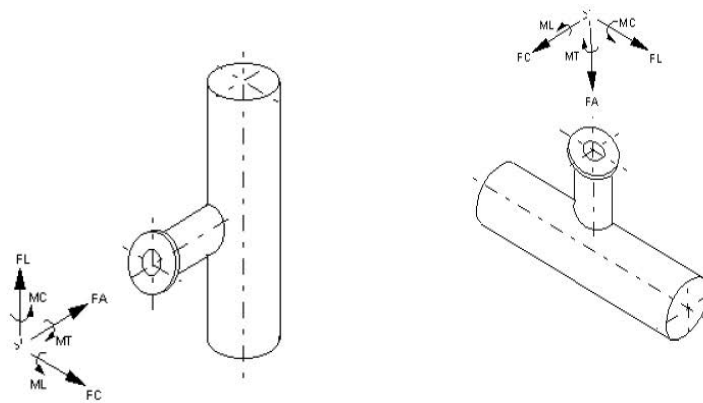
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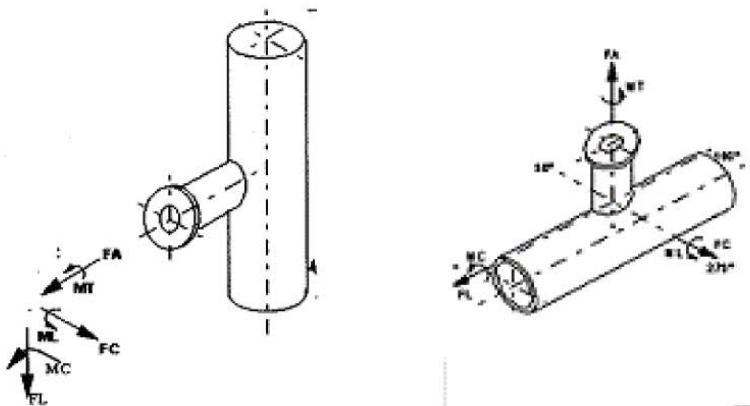
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NOZZ. SIZE	FLANGE RATING	NOZZLE FORCES (N)				NOZZLE MOMENTS (Nm)			
		FL	FA	FC	F	MT	ML	MC	M
16	150#	24000	24000	18000	25440	28800	24960	19200	27072
16	300#	24000	24000	18000	25440	28800	24960	19200	27072
16	600#	40000	40000	30000	42400	48000	41600	32000	45120
16	900#	48000	48000	36000	50880	57600	49920	38400	54144
16	1500#	64000	64000	48000	67840	76800	66560	51200	72192
18	150#	27000	27000	20250	28620	36450	31590	24300	34263
18	300#	27000	27000	20250	28620	36450	31590	24300	34263
18	600#	45000	45000	33750	47700	60750	52650	40500	57105
18	900#	54000	54000	40500	57240	72900	63180	48600	68526
18	1500#	72000	72000	54000	76320	97200	84240	64800	91368
20	150#	30000	30000	22500	31800	45000	39000	30000	42300
20	300#	30000	30000	22500	31800	45000	39000	30000	42300
20	600#	50000	50000	37500	53000	75000	65000	50000	70500
20	900#	60000	60000	45000	63600	90000	78000	60000	84600
20	1500#	80000	80000	60000	84800	120000	104000	80000	112800
22	150#	33000	33000	24750	34980	54450	47190	36300	51183
22	300#	33000	33000	24750	34980	54450	47190	36300	51183
22	600#	55000	55000	41250	58300	90750	78650	60500	85305
22	900#	66000	66000	49500	69960	108900	94380	72600	102366
22	1500#	88000	88000	66000	93280	145200	125840	96800	136488
24	150#	36000	36000	27000	38160	64800	56160	43200	60912
24	300#	36000	36000	27000	38160	64800	56160	43200	60912
24	600#	60000	60000	45000	63600	108000	93600	72000	101520
24	900#	72000	72000	54000	76320	129600	112320	86400	121824
24	1500#	96000	96000	72000	101760	172800	149760	115200	162432
26	150#	39000	39000	29250	41340	76050	65910	50700	71487
26	300#	39000	39000	29250	41340	76050	65910	50700	71487
26	600#	65000	65000	48750	68900	126750	109850	84500	119145
26	900#	78000	78000	58500	82680	152100	131820	101400	142974
26	1500#	104000	104000	78000	110240	202800	175760	135200	190632
28	150#	42000	42000	31500	44520	88200	76440	58800	82908
28	300#	42000	42000	31500	44520	88200	76440	58800	82908
28	600#	70000	70000	52500	74200	147000	127400	98000	138180
28	900#	84000	84000	63000	89040	176400	152880	117600	165816
28	1500#	112000	112000	84000	118720	235200	203840	156800	221088
30	150#	45000	45000	33750	47700	101250	87750	67500	95175
30	300#	45000	45000	33750	47700	101250	87750	67500	95175
30	600#	75000	75000	56250	79500	168750	146250	112500	158625
30	900#	90000	90000	67500	95400	202500	175500	135000	190350
30	1500#	120000	120000	90000	127200	270000	234000	180000	253800
32	150#	48000	48000	36000	50880	115200	99840	76800	108288
32	300#	48000	48000	36000	50880	115200	99840	76800	108288
32	600#	80000	80000	60000	84800	192000	166400	128000	180480
32	900#	96000	96000	72000	101760	230400	199680	153600	216576
32	1500#	128000	128000	96000	135680	307200	266240	204800	288768



ORIENTATION OF THE FORCES AND MOMENTS AS PER WRC BULETTIN107



ORIENTATION OF THE FORCES AND MOMENTS AS PER PD 5500

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PIPING MATERIAL SPECIFICATION
AMMONIA UREA COAL BASED FERTILIZER PROJECT.
TALCHER FERTILIZER LTD., ODISHA.

5	22.02.2022	22.02.2022	ISSUED FOR USE	NAZ	NS	GL/HOD
4	12.10.2021	12.10.2021	ISSUED FOR COMMENT	NAZ	NS/RK	GL/HOD
3	03.02.2021	03.02.2021	ISSUED FOR COMMENT	VINEETA	NS/RK	GL/HOD
2	28.12.2020	28.12.2020	ISSUED FOR COMMENT	VINEETA	NS/RK	GL/HOD
1	25.15.2020	28.12.2017	ISSUED	VINEETA	NS/RK	GL/HOD
0	09.03.2020	09.03.2020	ISSUED	VINEETA	NS/RK	GL/HOD
REV	REV DATE	EFF DATE	PURPOSE	PREPD	REVWD	APPD

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- **Service Index**
- **Piping Element Data Sheets**
- **Branch Tables**
- **Valve Data Sheets**
- **Strainer Data sheets**
- **Other Standards**

		Service Index (SI) of Piping Material Classes		TFL-PDS-600		5
				DOCUMENT NO.		REV. NO.
SL.NO.	PMC	SERVICE	RATING, FACE ,D.TEMP.	BASIC MATERIAL	CORROSION ALLOW. (MIN.)	REV. NO.
1	B14	AG,AL,FG	CLASS 150, RF,250°C Max, -33°C Min.	LTCS	1.5 MM	1
2	B20	CW (UG)	CLASS 150, RF, 70°C Max	CS	1.5MM	1
3	B22G	DW	CLASS 150, RF, 70°C Max	CS (GALV)	1.5MM	1
4	B22IS	CONST.WATER	CLASS 150, FF, 80°C Max	CS	1.5 MM	1
5	B22ISG	FW	CLASS 150, FF, 80°C Max	CS (GALV)	1.5 MM	0
6	B24	BD,CW,CWS,CWR,DO,ES,FG,FN,FO,FW,IAW,NI,PA,PG,PN,PV,PW,SA,SC,SW,TC,WW.	CLASS 150, RF, 200 °C Max	CS	1.5 MM	1
7	B24D	WASTE EFFLUENT	CLASS 150, FF, 50°C Max	HDPE	0.0 MM	0
8	B24FL	EFFLUENT,ACIDIC H2O ETC.	CLASS 150, FF, 80°C Max	CS FRP LINED	1.5 MM	0
9	B24G	FW	CLASS 150, FF, 200 °C Max	CS (GALV)	1.5 MM	0
10	B24P	ETP	CLASS 150, FF, 80°C Max	CPVC	0.0 MM	0
11	B24RL	EFFLUENT, WASTE H2O, CHLORINATED H2O	CLASS 150, FF, 80°C Max	CSRL	1.5 MM	0
12	B24S	SL,SC (IBR)	CLASS 150, RF, 240°C Max	CS	1.5 MM	0
13	B24Z	FLARE	CLASS 150, RF, 400 °C Max	CS	3.0 MM	1
14	B40	CD,FG,HG,PA,PC	CLASS 150, RF,150°C Max	304L SS	0.0 MM	0
15	B50	AF, AW, CD, DW, HZ, IA, MDA, PC, PH, VS	CLASS 150, RF,150°C Max	304 SS	0.0 MM	1
16	B52	UL, WET ACID FLARE GAS	CLASS 150, RF,150°C Max	316L SS	0.0 MM	2
17	D14	AG,AL,FG	CLASS 300, RF,70°C Max, -35°C Min.	LTCS	1.5 MM	1
18	D24	AG,AL,AW,FG,FN,HG,IAH,IAW, PA	CLASS 300, RF,280°C Max	CS	1.5 MM	0
19	D50	AW,PH,PC	CLASS 300, RF,200°C Max	304 SS	0.0 MM	0
20	D52	UL	CLASS 300, RF,150°C Max	316L SS	0.0 MM	2
21	F24	AW,HG,PA,PC,PN,SG	CLASS 600, RF,425°C Max	CS	1.5 MM	0
22	F24S	BB,BF,SC,SM	CLASS 600, RF,425°C Max	CS(IBR)	1.5 MM	0
23	H24S	BB,BF,SC,SH	CLASS 1500, RJ,340°C Max	CS(IBR)	1.5MM	0
24	J36S	SC,SH	CLASS 2500, RJ,540°C Max	AS(IBR)	1.5 MM	1

Abbrev. Service
 AF Antifoam solution
 AG Ammonia Gaseous
 AL/LA Ammonia Liquid
 AW Ammonia water
 BB Boiler BlowDown
 BD Blow Down
 BF Boiler feed water
 CD CO2/Steam mixture
 CW Cooling water
 CWS Cooling water supply
 CWR Cooling water return
 DM DM water
 DW Drinking Water

DO Diesel Oil
 ES Exhaust steam
 FG Fuel gas
 FO Fuel oil
 FN Fuel Naphtha
 FW Fire Water
 HC Mixed Hydrocarbons
 HG Hydrogen Gas
 HZ Hydrazine
 IA Instrument air
 IAH Instrument air(High pressure)
 IAW Instrument air(Wet)
 IG Inert gas
 NG Natural gas
 NI Nitrogen
 PA Process Air
 PC Process condensate
 PG Process Gas

Abbrev. Service
 PH Phosphate Solution
 PN Process Nephtha
 PV Vent gas
 PW Process Water
 SA service air
 SC Steam condensate
 SG Synthesis Gas
 SH/HPS/HP High Pressure Steam
 SL/LP/LPS LP Steam
 SM/MPS Medium Pressure Steam
 SW Service water
 TC Turbine Condensate
 UL Urea solutions handling

WW Waste Water

**PIPING MATERIAL SPECIFICATION**

CLIENT : M/S..TFL
 PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
 LOCATION : TALCHER,ODISHA

Project ..TFL
 DOC. No.TFL-PDS-600
 Rev.:1

Class: B14

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE AG,AL,FG		TEMPERATURE LIMITS (Deg.C)					
		Ref.SI	Ref.SI				
RATING ASME 150# RF	CORROSION ALLOWANCE 1.5 MM(MIN.)	MATERIAL LT CS					
ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
PIPE							
PIPE		2 - 21/2	SCH 40	BE	SMLS,ASTM A333 GR.6,ASME B36.10,	PPP611300	
PIPE		3 - 4	SCH 40	BE	SMLS,ASTM A333 GR.6,ASME B36.10,	PPP611300	
PIPE		5 - 6	SCH 40	BE	SMLS,ASTM A333 GR.6,ASME B36.10,	PPP611300	
PIPE		8 - 10	SCH 20	BE	SMLS,ASTM A333 GR.6,ASME B36.10,	PPP611300	
PIPE		12 - 12	SCH 20	BE	SMLS,ASTM A333 GR.6,ASME B36.10,	PPP611300	
PIPE		14 - 16	SCH 10	BE	SMLS,ASTM A333 GR.6,ASME B36.10,	PPP611300	
PIPE		1/2 - 3/4	SCH 80	PE	SMLS,ASTM A333 GR.6,ASME B36.10,	PPP621300	
PIPE		1 - 11/4	SCH 80	PE	SMLS,ASTM A333 GR.6,ASME B36.10,	PPP621300	
PIPE		11/2 - 11/2	SCH 80	PE	SMLS,ASTM A333 GR.6,ASME B36.10,	PPP621300	
PIPE		18 - 20	SCH 10	BE	SMLS,ASTM A333 GR.6,ASME B36.10,	PPP611300	
PIPE		22 - 24	SCHSTD	BE	SMLS,ASTM A333 GR.6,ASME B36.10,	PPP611300	
FLANGE							
LONG W.N.FLANGE		1 - 1	300#	WN-RF 125 AARH	ASTM A350 LF2 CL.1,ASME B16.5,24mmBORE,200mmLONG	LN3570802	
W.N.FLANGE		1/2 - 24	150#	WN-RF 125 AARH	ASTM A350 LF2 CL.1,ASME B16.5,WELD NECK	WN3570801	5
W.N.FLANGE		1/2 - 24	300#	WN-RF 125 AARH	ASTM A350 LF2 CL.1,ASME B16.5,WELD NECK	WN3570802	6
SPACER AND BLIND		14 - 24	150#	RF 125 AARH	ASTM A350 LF2 CL.1,ASME B16.48,	RS352PO01	
SPECL BLIND		1/2 - 12	150#	RF 125 AARH	ASTM A350 LF2 CL.1,ASME B16.48,	SP352PO01	
BLIND FLANGE							
BLIND FLANGE		1/2 - 24	150#	RF 125 AARH	ASTM A350 LF2 CL.1,ASME B16.5,	BF3520801	
GASKET							
GASKET		1/2 - 24	150#	SPRL-WND RF	TP304 SS WDG;GPH FLR;TP304 SS INR RNG;CS OTR RNG,ASME B16.20,	GSQN30301	
STUD & NUTS							
STUD & 2NUTS HVY		-			ASTM A320 GR.L7/ASTM A194 GR.7,,	SNDA00000	
HEX							
FITTING (BW)							
BRANCH WELD WITH RP		2 - 24		BW	LT CARBON STEEL,ASME B31.3,	WBE211200	
CAP		2 - 24		BW	ASTM A420 WPL6-SMLS,ASME B16.9,	CP4910900	
ELBOW		2 - 24		BW	ASTM A420 WPL6-SMLS,ASME B16.9,	EL4910900	
REDUCER CONC.		2 - 24		BW	ASTM A420 WPL6-SMLS,ASME B16.9,	RC4910900	
REDUCER ECC.		2 - 24		BW	ASTM A420 WPL6-SMLS,ASME B16.9,	RE4910900	
TEE		2 - 24		BW	ASTM A420 WPL6-SMLS,ASME B16.9,	TE4910900	
WELDOLET		2 - 24		BW	ASTM A350 LF2 CL.1,MSS SP 97,	WL3513300	
FITTING (SW)							
CAP		1/2 - 11/2	3000#	SOCW	ASTM A350 LF2 CL.1,ASME B16.11,	CP3530207	W
COUPLING		1/2 - 11/2	3000#	SOCW	ASTM A350 LF2 CL.1,ASME B16.11,	CN3530207	
ELBOW		1/2 - 11/2	3000#	SOCW	ASTM A350 LF2 CL.1,ASME B16.11,	EL3530207	
HALF COUPLING		1/2 - 11/2	3000#	SOCW	ASTM A350 LF2 CL.1,ASME B16.11,	HF3530207	W
SOCKOLET		1/2 - 24	3000#	SOCW	ASTM A350 LF2 CL.1,MSS SP 97,	SL3533307	
TEE		1/2 - 11/2	3000#	SOCW	ASTM A350 LF2 CL.1,ASME B16.11,	TE3530207	
FITTING (THD)							
CAP		1/2 - 11/2	3000#	THD	ASTM A350 LF2 CL.1,ASME B16.11,	CP3540207	T
HALF COUPLING		1/2 - 11/2	3000#	THD	ASTM A350 LF2 CL.1,ASME B16.11,	HF3540207	T
PLUG		1/2 - 11/2		THD	ASTM A350 LF2 CL.1,ASME B16.11,ROUND HEAD	PG3540200	
THREDOLET		1/2 - 24	3000#	THD	ASTM A350 LF2 CL.1,MSS SP 97,	TL3543307	
NIPPLE							
NIPPLE		1/2 - 11/2	SCH160	PLN-PLN	SMLS,ASTM A333 GR.6,ASME B36.10,	NPP651312	1
NIPPLE		1/2 - 11/2	SCH160	PLN-THD	SMLS,ASTM A333 GR.6,ASME B36.10,NPT	NPP661312	2
NIPPLE		1/2 - 11/2	SCH160	THD	SMLS,ASTM A333 GR.6,ASME B36.10,NPT	NPP641312	3
SWAGE NIPPLE							
SWAGE (CONC)		1/2 - 11/2		PE	ASTM A420 WPL6-SMLS,MSS SP 95,	NC49J4500	



PIPING MATERIAL SPECIFICATION

CLIENT : M/S..TFL
 PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
 LOCATION : TALCHER,ODISHA

Project :TFL
 DOC. No.TFL-PDS-600
 Rev.:1

Class: B14

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE AG,AL,FG	TEMPERATURE LIMITS (Deg.C)			
	Ref.SI	Ref.SI		
RATING ASME 150# RF	CORROSION ALLOWANCE 1.5 MM(MIN.)	MATERIAL LT CS		

ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
SWAGE (ECC)		1/2 - 1 1/2		PE	ASTM A420 WPL6-SMLS,MSS SP 95,	NE49J4500	
VALVES							
GATE VALVE		1/2 - 1 1/2	800#	SOCW	LTCS BODY ASTM A350 GR LF2,GAV101,	GAV101	W
GATE VALVE		1/2 - 1 1/2	150#	FLG	LTCS BODY ASTM A352 GR LCB,GAV110,	GAV110	F
GATE VALVE		2 - 24	150#	FLG	LTCS BODY ASTM A352 GR LCB,GAV110,	GAV110	
GLOBE VALVE		1/2 - 1 1/2	800#	SOCW	LTCS BODY ASTM A350 GR LF2,GLV101,	GLV101	W
GLOBE VALVE		2 - 8	150#	FLG	LTCS BODY ASTM A352 GR LCB,GLV110,	GLV110	
GLOBE VALVE		1/2 - 1 1/2	150#	FLG	LTCS BODY ASTM A352 GR LCB,GLV110,	GLV110	F
CHECK VALVE		1/2 - 1 1/2	800#	SOCW	LTCS BODY ASTM A350 GR LF2,CHV101,	CHV101	
CHECK VALVE		2 - 24	150#	FLG	LTCS BODY ASTM A352 GR LCB,CHV110,	CHV110	
BALL VALVE		1/2 - 1 1/2	800#	SOCW	LTCS BODY ASTM A350 GR LF2,BAV101,	BAV101	W
BALL VALVE		1/2 - 1 1/2	150#	FLG	LTCS BODY ASTM A352 GR LCB,BAV110,	BAV110	F
BALL VALVE		2 - 24	150#	FLG	LTCS BODY ASTM A352 GR LCB,BAV110,	BAV110	
BUTTERFLY VALVE		2 - 24	150#	FLG	LTCS BODY ASTM A352 GR LCB,BUV101,	BUV101	

**PIPING MATERIAL SPECIFICATION**

CLIENT : M/S..TFL
 PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
 LOCATION : TALCHER,ODISHA

Project ..TFL
 DOC. No.TFL-PDS-600
 Rev.:1

Class: B20

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE CW(UG)	TEMPERATURE LIMITS (Deg.C)			
	Ref.SI	Ref.SI		
RATING ASME 150# RF	CORROSION ALLOWANCE 1.5 MM(MIN.)	MATERIAL CS		

ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
PIPE							
PIPE		2 - 6	SCH 40	BE	SMLS,API 5L GR.B,C&W,ASME B36.10,	PPX111300	
PIPE		40 - 42	10.00 MM	BE	LSAW,IS 3589 GR.FE410 C&W,ASME B36.10,	PPQW11300	
PIPE		44 - 46	10.00 MM	BE	LSAW,IS 3589 GR.FE410 C&W,ASME B36.10,	PPQW11300	
PIPE		48 - 48	10.00 MM	BE	LSAW,IS 3589 GR.FE410 C&W,ASME B36.10,	PPQW11300	
PIPE		8 - 10	SCH 10	BE	ERW,API 5L GR.B,C&W,ASME B36.10,	PPX411300	
PIPE		12 - 14	SCH 10	BE	ERW,API 5L GR.B,C&W,ASME B36.10,	PPX411300	
PIPE		16 - 18	SCH 10	BE	LSAW,API 5L GR.B,C&W,ASME B36.10,	PP1A11300	
PIPE		20 - 24	SCH 10	BE	LSAW,API 5L GR.B,C&W,ASME B36.10,	PP1A11300	
PIPE		1/2 - 3/4	SCH 80	PE	SMLS,API 5L GR.B,C&W,ASME B36.10,	PPX121300	
PIPE		1 - 1 1/4	SCH 80	PE	SMLS,API 5L GR.B,C&W,ASME B36.10,	PPX121300	
PIPE		1 1/2 - 1 1/2	SCH 80	PE	SMLS,API 5L GR.B,C&W,ASME B36.10,	PPX121300	
PIPE		26 - 28	08.00 MM	BE	LSAW,IS 3589 GR.FE410 C&W,ASME B36.10,	PPQW11300	
PIPE		30 - 32	08.00 MM	BE	LSAW,IS 3589 GR.FE410 C&W,ASME B36.10,	PPQW11300	
PIPE		34 - 36	08.00 MM	BE	LSAW,IS 3589 GR.FE410 C&W,ASME B36.10,	PPQW11300	
PIPE		38 - 38	08.00 MM	BE	LSAW,IS 3589 GR.FE410 C&W,ASME B36.10,	PPQW11300	
PIPE		52 - 54	12.00 MM	BE	LSAW,IS 3589 GR.FE410 C&W,ASME B36.10,	PPQW11300	
PIPE		56 - 58	12.00 MM	BE	LSAW,IS 3589 GR.FE410 C&W,ASME B36.10,	PPQW11300	
PIPE		60 - 62	12.00 MM	BE	LSAW,IS 3589 GR.FE410 C&W,ASME B36.10,	PPQW11300	
PIPE		64 - 66	12.00 MM	BE	LSAW,IS 3589 GR.FE410 C&W,ASME B36.10,	PPQW11300	
PIPE		68 - 70	14.00 MM	BE	LSAW,IS 3589 GR.FE410 C&W,ASME B36.10,	PPQW11300	
PIPE		72 - 72	14.00 MM	BE	LSAW,IS 3589 GR.FE410 C&W,ASME B36.10,	PPQW11300	
FLANGE							
FLANGE		1/2 - 24	150#	SO-RF 125 AARH	CS ASTM A105,ASME B16.5,SLIP ON	FL0260801	
FLANGE		26 - 72	150#	SO-FF	IS2062 GR.B,AWWA C207-D,RING TYPE,SLIP ON	FLA452701	
SPACER AND BLIND		14 - 24	150#	RF 125 AARH	CS ASTM A105,ASME B16.48,	RS022P001	
SPECL BLIND		1/2 - 12	150#	RF 125 AARH	CS ASTM A105,ASME B16.48,	SP022P001	
BLIND FLANGE							
BLIND FLANGE		1/2 - 24	150#	RF 125 AARH	CS ASTM A105,ASME B16.5,	BF0220801	
BLIND FLANGE		26 - 72	150#	FF	IS2062 GR.B,AWWA C207-D,	BFA412701	
GASKET							
GASKET		1/2 - 24	150#	SPRL-WND RF	TP304 SS WDG,GPH FLR;TP304 SS INR RNG;CS OTR RNG,ASME B16.20,	GSQN30301	
GASKET		26 - 72	150#	3.0 MM THK FF	GSKT FLAT RNG,GARLOCK 3000(SYN FBR W/NBR BDR),ASME B16.21/AWWA C207-D,RING TYPE	GSTO8QS01	
STUD & NUTS							
STUD & 2NUTS HVY		-			ASTM A193 GR.B7/ASTM A194 GR.2H,,	SNDE00000	
FITTING (BW)							
BRANCH WELD		2 - 48		BW	CARBON STEEL,ASME B31.3,	RWOJ11200	
BRANCH WELD WITH RP		2 - 48		BW	CARBON STEEL,ASME B31.3,	WBOJ11200	
CAP		2 - 24		BW	ASTM A234 WPB-SMLS,ASME B16.9,	CP7310900	
ELBOW		8 - 24		BW	ASTM A234 WPB-WLDD,ASME B16.9,	ELOY10900	
ELBOW		2 - 6		BW	ASTM A234 WPB-SMLS,ASME B16.9,	EL7310900	
ELBOW		26 - 48		BW	IS2062 GR.B,ASME B16.9,	ELA410900	
REDUCER CONC.		2 - 6		BW	ASTM A234 WPB-SMLS,ASME B16.9,	RC7310900	
REDUCER CONC.		8 - 24		BW	ASTM A234 WPB-WLDD,ASME B16.9,	RCOY10900	
REDUCER CONC.		26 - 48		BW	IS2062 GR.B,ASME B16.9,	RCA410900	
REDUCER ECC.		2 - 6		BW	ASTM A234 WPB-SMLS,ASME B16.9,	RE7310900	
REDUCER ECC.		8 - 24		BW	ASTM A234 WPB-WLDD,ASME B16.9,	REOY10900	
REDUCER ECC.		26 - 48		BW	IS2062 GR.B,ASME B16.9,	REA410900	

**PIPING MATERIAL SPECIFICATION**

CLIENT : M/S..TFL
 PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
 LOCATION : TALCHER,ODISHA

Project :TFL
 DOC. No.TFL-PDS-600
 Rev.:1

Class: B20

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE CW(UG)	TEMPERATURE LIMITS (Deg.C)			
	Ref.SI	Ref.SI		
RATING ASME 150# RF	CORROSION ALLOWANCE 1.5 MM(MIN.)	MATERIAL CS		

ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
TEE		2 - 6		BW	ASTM A234 WPB-SMLS,ASME B16.9,	TE7310900	
TEE		8 - 24		BW	ASTM A234 WPB-WLDD,ASME B16.9,	TEOY10900	
TEE		26 - 48		BW	IS2062 GR.B,ASME B16.9,	TEA410900	
WELDOLET		2 - 48		BW	CS ASTM A105,MSS SP 97,	WL0213300	
FITTING (SW)							
CAP		1/2 - 11/2	3000#	SOCW	CS ASTM A105,ASME B16.11,	CP0230207	W
COUPLING		1/2 - 11/2	3000#	SOCW	CS ASTM A105,ASME B16.11,	CN0230207	
ELBOW		1/2 - 11/2	3000#	SOCW	CS ASTM A105,ASME B16.11,	EL0230207	
SOCKOLET		1/2 - 48	3000#	SOCW	CS ASTM A105,MSS SP 97,	SL0233307	
TEE		1/2 - 11/2	3000#	SOCW	CS ASTM A105,ASME B16.11,	TE0230207	
FITTING (THD)							
CAP		1/2 - 11/2	3000#	THD	CS ASTM A105,ASME B16.11,	CP0240207	T
PLUG		1/2 - 11/2		THD	CS ASTM A105,ASME B16.11,ROUND HEAD	PG0240200	
THREDOLET		1/2 - 48	3000#	THD	CS ASTM A105,MSS SP 97,	TL0243307	
NIPPLE							
NIPPLE		1/2 - 11/2	SCH160	PLN-PLN	SMLS,API 5L GR.B,ASME B36.10,	NPA151312	1
NIPPLE		1/2 - 11/2	SCH160	PLN-THD	SMLS,API 5L GR.B,ASME B36.10,NPT	NPA161312	2
NIPPLE		1/2 - 11/2	SCH160	THD	SMLS,API 5L GR.B,ASME B36.10,NPT	NPA141312	3
SWAGE NIPPLE							
SWAGE (CONC)		1/2 - 11/2		PE	ASTM A234 WPB-SMLS,MSS SP 95,	NC73J4500	
SWAGE (ECC)		1/2 - 11/2		PE	ASTM A234 WPB-SMLS,MSS SP 95,	NE73J4500	
VALVES							
GATE VALVE		1/2 - 11/2	800#	SOCW	CS BODY ASTM A105,GAV201,	GAV201	
GATE VALVE		2 - 48	150#	FLG	CS BODY ASTM A216 GR WCB,GAV210,	GAV210	
GLOBE VALVE		1/2 - 11/2	800#	SOCW	CS BODY ASTM A105,GLV201,	GLV201	
GLOBE VALVE		2 - 10	150#	FLG	CS BODY ASTM A216 GR WCB,GLV210,	GLV210	
BUTTERFLY VALVE		2 - 24	150#	RF	CS BODY ASTM A216 GR WCB,BUV203,LUG TYPE	BUV203	

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**PIPING MATERIAL SPECIFICATION**

CLIENT : M/S..TFL
 PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
 LOCATION : TALCHER,ODISHA

Project ..TFL
 DOC. No.TFL-PDS-600
 Rev.:2

Class: B22G

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE DW,AIR	TEMPERATURE LIMITS (Deg.C)						
	Ref.SI	Ref.SI					
RATING ASME 150# THD	CORROSION ALLOWANCE 1.5 MM(MIN.)		MATERIAL CS(GALVANISED)				
ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
PIPE							
PIPE		1/2 - 3/4	SCH XS	THD	SMLS,ASTM A106 GR.B,HOT DIP GALV.,ASME B36.10,	PPAC31300	
PIPE		1 - 1 1/4	SCH XS	THD	SMLS,ASTM A106 GR.B,HOT DIP GALV.,ASME B36.10,	PPAC31300	
PIPE		1 1/2 - 2	SCH XS	THD	SMLS,ASTM A106 GR.B,HOT DIP GALV.,ASME B36.10,	PPAC31300	
PIPE		2 1/2 - 3	SCHSTD	THD	SMLS,ASTM A106 GR.B,HOT DIP GALV.,ASME B36.10,	PPAC31300	
PIPE		4 - 4	SCHSTD	THD	SMLS,ASTM A106 GR.B,HOT DIP GALV.,ASME B36.10,	PPAC31300	
PIPE		6 - 8	SCHSTD	BE	SMLS,ASTM A106 GR.B,HOT DIP GALV.,ASME B36.10,	PPAC11300	
FLANGE							
FLANGE		1/2 - 4	150#	THD-RF 125 AARH	ASTM A105 HOT DIP GALV.,ASME B16.5,	FLFDK0801	
W.N.FLANGE		6 - 8	150#	WN-RF 125 AARH	ASTM A105 HOT DIP GALV.,ASME B16.5,	WNFD70801	
SPECL BLIND		1/2 - 8	150#	THD-RF 125 AARH	ASTM A105 HOT DIP GALV.,ASME B16.48,	SPFDKPO01	
BLIND FLANGE							
BLIND FLANGE		1/2 - 8	150#	RF 125 AARH	ASTM A105 HOT DIP GALV.,ASME B16.5,	BFFD20801	
GASKET							
GASKET		6 - 8	150#	SPRL-WND RF	TP304 SS WDG;GPH FLR;TP304 SS INR RNG;CS OTR RNG,ASME B16.20,	GSQN30301	
GASKET		1/2 - 4	150#	3.0 MM THK RF	BUTYL RUBBER,ASME B16.21,	GS6720401	
STUD & NUTS							
STUD & 2NUTS HVY		-			ASTM A193GR.B7/A194GR.2H,HOT DIP GALV.,,	SNZC00000	
HEX							
FITTING (BW)							
CAP		6 - 8		BW	ASTM A234 WPB-SMLS,HOT DIP GALV.,ASME B16.9,	CPPD10900	
ELBOW		6 - 8		BW	ASTM A234 WPB-SMLS,HOT DIP GALV.,ASME B16.9,	ELPD10900	
REDUCER CONC.		6 - 8		BW	ASTM A234 WPB-SMLS,HOT DIP GALV.,ASME B16.9,	RCPD10900	
REDUCER ECC.		6 - 8		BW	ASTM A234 WPB-SMLS,HOT DIP GALV.,ASME B16.9,	REPD10900	
TEE		6 - 8		BW	ASTM A234 WPB-SMLS,HOT DIP GALV.,ASME B16.9,	TEPD10900	
WELDOLET		6 - 8		BW	ASTM A105 HOT DIP GALV.,MSS SP 97,	WLF13300	
FITTING (THD)							
CAP		1/2 - 4	3000#	THD	ASTM A105 HOT DIP GALV.,ASME B16.11,	CPFD40207	
COUPLING		1/2 - 1 1/2	3000#	THD	ASTM A105 HOT DIP GALV.,ASME B16.11,	CNFD40207	
ELBOW		1/2 - 4	3000#	THD	ASTM A105 HOT DIP GALV.,ASME B16.11,	ELFD40207	
HALF COUPLING		1/2 - 1 1/2	3000#	THD	ASTM A105 HOT DIP GALV.,ASME B16.11,	HFFD40207	
PLUG		1/2 - 1 1/2		THD	ASTM A105 HOT DIP GALV.,ASME B16.11,ROUND HEAD	PGFD40200	
REDUCER CONC.		2 - 4		THD	ASTM A105 HOT DIP GALV.,ASME B16.11,	RCFD40200	
REDUCER ECC.		2 - 4		THD	ASTM A105 HOT DIP GALV.,ASME B16.11,	REFD40200	
TEE		1/2 - 4	3000#	THD	ASTM A105 HOT DIP GALV.,ASME B16.11,	TEFD40207	
THREDOLET		1/2 - 1 1/2	3000#	THD	ASTM A105 HOT DIP GALV.,MSS SP 97,	TLFD43307	
NIPPLE							
NIPPLE		1/2 - 12		THD	SMLS,ASTM A106 GR.B,HOT DIP GALV.,ASME B36.10,NPT	NPAC41344	
SWAGE NIPPLE							
SWAGE (CONC)		1/2 - 1 1/2		THD	ASTM A105 HOT DIP GALV.,MSS SP 95,	NCFD44500	
SWAGE (ECC)		1/2 - 1 1/2		THD	ASTM A105 HOT DIP GALV.,MSS SP 95,	NEFD44500	
VALVES							
GATE VALVE		2 - 8	150#	FLG	CS BODY ASTM A216 GR WCB,GAV210,	GAV210	
GATE VALVE		1/2 - 1 1/2	800#	THRD	CS BODY ASTM A105,GAV207,	GAV207	
CHECK VALVE		1/2 - 1 1/2	800#	THRD	CS BODY ASTM A105,CHV207,	CHV207	
CHECK VALVE		2 - 8	150#	FLG	CS BODY ASTM A216 GR WCB,CHV210,	CHV210	
BUTTERFLY VALVE		2 - 8	150#	RF	CS BODY ASTM A216 GR WCB,BUV203,LUG TYPE	BUV203	
PLUG VALVE		2 - 8	150#	FLG	CS BODY ASTM A216 GR WCB,PLV202,	PLV202	

Note : 1. Hot Dip Galvanizing shall be done in accordance with ASTM A53 for Pipes & ASTM A153 for flanged & fittings.

2.Surface where Galvanizing has been burnt off during welding etc. shall be wire brushed ,zinc coated or cold galvanized.

**PIPING MATERIAL SPECIFICATION**

CLIENT : M/S..TFL
 PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
 LOCATION : TALCHER,ODISHA

Project ..TFL
 DOC. No.TFL-PDS-600
 Rev.:1

Class: B22IS

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE		TEMPERATURE LIMITS (Deg.C)					
CONSTRUCTION WATER		Ref.SI	Ref.SI				
RATING ASME	CORROSION ALLOWANCE	MATERIAL					
150# RF	1.5 MM(MIN.)	CS					
ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
PIPE							
PIPE		2 - 2 1/2	04.50 MM	BE	SMLS,IS1239 BLACK,IS 1239 PART I,HVY	PPD512600	
PIPE		3 - 3	4.80 MM	BE	SMLS,IS1239 BLACK,IS 1239 PART I,HVY	PPD512600	
PIPE		4 - 5	05.40 MM	BE	SMLS,IS1239 BLACK,IS 1239 PART I,HVY	PPD512600	
PIPE		6 - 6	05.40 MM	BE	SMLS,IS1239 BLACK,IS 1239 PART I,HVY	PPD512600	
PIPE		1/2 - 3/4	3.20 MM	PE	SMLS,IS1239 BLACK,IS 1239 PART I,HVY	PPD522600	
PIPE		1 - 1 1/4	04.00 MM	PE	SMLS,IS1239 BLACK,IS 1239 PART I,HVY	PPD522600	
PIPE		1 1/2 - 1 1/2	04.00 MM	PE	SMLS,IS1239 BLACK,IS 1239 PART I,HVY	PPD522600	
PIPE		8 - 10	6.30 MM	BE	ERW,IS 3589 GR.FE410,IS 3589,	PP521PK00	
PIPE		12 - 14	6.30 MM	BE	ERW,IS 3589 GR.FE410,IS 3589,	PP521PK00	
PIPE		16 - 18	6.30 MM	BE	LSAW,IS 3589 GR.FE410,IS 3589,	PPT11PK00	
PIPE		20 - 20	6.30 MM	BE	LSAW,IS 3589 GR.FE410,IS 3589,	PPT11PK00	
PIPE		22 - 24	08.00 MM	BE	LSAW,IS 3589 GR.FE410,IS 3589,	PPT11PK00	
PIPE		26 - 28	08.00 MM	BE	LSAW,IS 3589 GR.FE410,IS 3589,	PPT11PK00	
PIPE		30 - 30	08.00 MM	BE	LSAW,IS 3589 GR.FE410,IS 3589,	PPT11PK00	
PIPE		32 - 34	10.00 MM	BE	LSAW,IS 3589 GR.FE410,IS 3589,	PPT11PK00	
PIPE		36 - 38	10.00 MM	BE	LSAW,IS 3589 GR.FE410,IS 3589,	PPT11PK00	
PIPE		40 - 42	12.00 MM	BE	LSAW,IS 3589 GR.FE410,IS 3589,	PPT11PK00	
PIPE		44 - 46	12.00 MM	BE	LSAW,IS 3589 GR.FE410,IS 3589,	PPT11PK00	
PIPE		48 - 48	12.00 MM	BE	LSAW,IS 3589 GR.FE410,IS 3589,	PPT11PK00	
FLANGE							
FLANGE		1/2 - 1 1/2	150#	SW-RF 125 AARH	CS ASTM A105,ASME B16.5,	FL02L0801	
FLANGE		2 - 24	150#	SO-RF 125 AARH	CS ASTM A105,ASME B16.5,SLIP ON	FL0260801	1
FLANGE		26 - 48	150#	SO-FF	IS2062 GR.B,AWWA C207-D,RING TYPE,SLIP ON	FLA452701	C
LONG W.N.FLANGE		1 1/2 - 1 1/2	300#	WN-RF 125 AARH	CS ASTM A105,ASME B16.5,38mmBORE,200mmLONG	LN0270802	
W.N.FLANGE		26 - 48	150#	WN-RF 125 AARH	CS ASTM A105,ASME B16.47 SR.B,WELD NECK	WN0270701	B
W.N.FLANGE		2 - 24	150#	WN-RF 125 AARH	CS ASTM A105,ASME B16.5,WELD NECK	WN0270801	2
SPACER AND BLIND		14 - 24	150#	RF 125 AARH	CS ASTM A105,ASME B16.48,	RS022P001	
SPECL BLIND		1/2 - 12	150#	RF 125 AARH	CS ASTM A105,ASME B16.48,	SP022P001	
BLIND FLANGE							
BLIND FLANGE		26 - 48	150#	RF 125 AARH	CS ASTM A105,ASME B16.47 SR.B,	BF0220701	
BLIND FLANGE		1/2 - 24	150#	RF 125 AARH	CS ASTM A105,ASME B16.5,	BF0220801	
GASKET							
GASKET		1/2 - 24	150#	SPRL-WND RF	TP304 SS WDG;GPH FLR;TP304 SS INR RNG;CS OTR RNG,ASME B16.20,	GSQN30301	
GASKET		26 - 48	150#	SPRL-WND RF	TP304 SS WDG;GPH FLR;TP304 SS INR RNG;CS OTR RNG,ASME B16.20/B16.47 SR.B,	GSQN3QJ01	9
GASKET		26 - 48	150#	3.0 MM THK FF	GSKT FLAT RNG,GARLOCK 3000(SYN FBR W/NBR BDR),ASME B16.21/AWWA C207-D,RING TYPE	GSTO8QS01	F
STUD & NUTS							
STUD & 2NUTS HVY		-			ASTM A193 GR.B7/ASTM A194 GR.2H,,	SNDE00000	
FITTING (BW)							
BRANCH WELD		2 - 48		BW	CARBON STEEL,ASME B31.3,	RWOJ11200	
BRANCH WELD WITH RP		2 - 48		BW	CARBON STEEL,ASME B31.3,	WBOJ11200	
CAP		2 - 48		BW	ASTM A234 WPB-SMLS,ASME B16.9,	CP7310900	
ELBOW		2 - 6		BW	ASTM A234 WPB-SMLS,ASME B16.9,	EL7310900	
ELBOW		8 - 48		BW	ASTM A234 WPB-WLDD,ASME B16.9,	ELOY10900	
REDUCER CONC.		2 - 6		BW	ASTM A234 WPB-SMLS,ASME B16.9,	RC7310900	
REDUCER CONC.		8 - 48		BW	ASTM A234 WPB-WLDD,ASME B16.9,	RCOY10900	
REDUCER ECC.		2 - 6		BW	ASTM A234 WPB-SMLS,ASME B16.9,	RE7310900	
REDUCER ECC.		8 - 48		BW	ASTM A234 WPB-WLDD,ASME B16.9,	REOY10900	



PIPING MATERIAL SPECIFICATION

CLIENT : M/S..TFL
 PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
 LOCATION : TALCHER,ODISHA

Project :TFL
 DOC. No.TFL-PDS-600
 Rev.:1

Class: B22IS

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE		TEMPERATURE LIMITS (Deg.C)					
CONSTRUCTION WATER		Ref.SI	Ref.SI				
RATING ASME	CORROSION ALLOWANCE	MATERIAL					
150# RF	1.5 MM(MIN.)	CS					
ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
TEE		2 - 6		BW	ASTM A234 WPB-SMLS,ASME B16.9,	TE7310900	
TEE		8 - 48		BW	ASTM A234 WPB-WLDD,ASME B16.9,	TEOY10900	
WELDOLET		2 - 48		BW	CS ASTM A105,MSS SP 97,	WL0213300	
FITTING (SW)							
CAP		1/2 - 11/2	3000#	SOCW	CS ASTM A105,ASME B16.11,	CP0230207	W
COUPLING		1/2 - 11/2	3000#	SOCW	CS ASTM A105,ASME B16.11,	CN0230207	
ELBOW		1/2 - 11/2	3000#	SOCW	CS ASTM A105,ASME B16.11,	EL0230207	
SOCKOLET		1/2 - 48	3000#	SOCW	CS ASTM A105,MSS SP 97,	SL0233307	
TEE		1/2 - 11/2	3000#	SOCW	CS ASTM A105,ASME B16.11,	TE0230207	
FITTING (THD)							
CAP		1/2 - 11/2	3000#	THD	CS ASTM A105,ASME B16.11,	CP0240207	T
PLUG		1/2 - 11/2		THD	CS ASTM A105,ASME B16.11,ROUND HEAD	PG0240200	
THREDOLET		1/2 - 48	3000#	THD	CS ASTM A105,MSS SP 97,	TL0243307	
NIPPLE							
NIPPLE		1/2 - 11/2	SCH 80	PLN-PLN	SMLS,IS1239 BLACK,IS 1239 PART I,	NPD552611	1
NIPPLE		1/2 - 11/2	SCH 80	PLN-THD	SMLS,IS1239 BLACK,IS 1239 PART I,NPT	NPD562611	2
NIPPLE		1/2 - 11/2	SCH 80	THD	SMLS,IS1239 BLACK,IS 1239 PART I,NPT	NPD542611	3
SWAGE NIPPLE							
SWAGE (CONC)		1/2 - 11/2		PE	ASTM A234 WPB-SMLS,MSS SP 95,	NC73J4500	P
SWAGE (CONC)		1/2 - 11/2		PLN-THD	ASTM A234 WPB-SMLS,MSS SP 95,	NC7364500	T
SWAGE (ECC)		1/2 - 11/2		PE	ASTM A234 WPB-SMLS,MSS SP 95,	NE73J4500	P
SWAGE (ECC)		1/2 - 11/2		PLN-THD	ASTM A234 WPB-SMLS,MSS SP 95,	NE7364500	T
VALVES							
GATE VALVE		1/2 - 11/2	800#	SOCW	CS BODY ASTM A105,GAV201,	GAV201	W
GATE VALVE		1/2 - 11/2	150#	FLG	CS BODY ASTM A216 GR WCB,GAV210,	GAV210	F
GATE VALVE		2 - 24	150#	FLG	CS BODY ASTM A216 GR WCB,GAV210,	GAV210	
GLOBE VALVE		1/2 - 11/2	800#	SOCW	CS BODY ASTM A105,GLV201,	GLV201	
GLOBE VALVE		2 - 12	150#	FLG	CS BODY ASTM A216 GR WCB,GLV210,	GLV210	
CHECK VALVE		1/2 - 11/2	800#	SOCW	CS BODY ASTM A105,CHV201,	CHV201	
CHECK VALVE		2 - 24	150#	FLG	CS BODY ASTM A216 GR WCB,CHV210,	CHV210	
BALL VALVE		1/2 - 1	800#	SOCW	CS BODY ASTM A105,BAV201,	BAV201	
BALL VALVE		11/2 - 11/2	800#	SOCW	CS BODY ASTM A105,BAV201,	BAV201	W
BALL VALVE		11/2 - 11/2	150#	FLG	CS BODY ASTM A216 GR WCB,BAV210,	BAV210	F
BALL VALVE		2 - 16	150#	FLG	CS BODY ASTM A216 GR WCB,BAV210,	BAV210	
BUTTERFLY VALVE		3 - 24	150#	RF	CS BODY ASTM A216 GR WCB,BUV203,LUG TYPE	BUV203	
PLUG VALVE		1/2 - 1	600#	THRD	CS BODY ASTM A105,PLV201,	PLV201	
PLUG VALVE		11/2 - 24	150#	FLG	CS BODY ASTM A216 GR WCB,PLV202,	PLV202	

**PIPING MATERIAL SPECIFICATION**

CLIENT : M/S..TFL
 PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
 LOCATION : TALCHER,ODISHA

Project :TFL
 DOC. No.TFL-PDS-600
 Rev.:1

Class: B22ISG

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE FW	TEMPERATURE LIMITS (Deg.C)			
	Ref.SI	Ref.SI		
RATING ASME 150# THD	CORROSION ALLOWANCE 1.5 MM(MIN.)	MATERIAL CS(GALVANIZED)		

ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
PIPE							
PIPE		1/2 - 3/4	3.20 MM	THD	SMLS,IS1239 GALV.,IS 1239 PART I,HVY	PPDH32600	
PIPE		1 - 1 1/4	04.00 MM	THD	SMLS,IS1239 GALV.,IS 1239 PART I,HVY	PPDH32600	
PIPE		1 1/2 - 1 1/2	04.00 MM	THD	SMLS,IS1239 GALV.,IS 1239 PART I,HVY	PPDH32600	
PIPE		2 - 2 1/2	04.50 MM	THD	SMLS,IS1239 GALV.,IS 1239 PART I,HVY	PPDH32600	
PIPE		3 - 3	4.80 MM	THD	SMLS,IS1239 GALV.,IS 1239 PART I,HVY	PPDH32600	
PIPE		4 - 5	05.40 MM	THD	SMLS,IS1239 GALV.,IS 1239 PART I,HVY	PPDH32600	
PIPE		6 - 6	05.40 MM	THD	SMLS,IS1239 GALV.,IS 1239 PART I,HVY	PPDH32600	
FLANGE							
FLANGE		1/2 - 6	150#	THD-RF 125 AARH	ASTM A105 HOT DIP GALV.,ASME B16.5,	FLFDK0801	
SPECL BLIND		1/2 - 6	150#	RF 125 AARH	ASTM A105 HOT DIP GALV.,ASME B16.48,	SPFD2P001	
BLIND FLANGE							
BLIND FLANGE		1/2 - 6	150#	RF 125 AARH	ASTM A105 HOT DIP GALV.,ASME B16.5,	BFFD20801	
GASKET							
GASKET		1/2 - 4	150#	3.0 MM THK RF	BUTYL RUBBER,ASME B16.21,	GS6720401	
STUD & NUTS							
STUD & 2NUTS HVY		-			ASTM A193GR.B7/A194GR.2H,HOT DIP GALV.,,	SNZC00000	
HEX							
FITTING (THD)							
CAP		1/2 - 6	3000#	THD	ASTM A105 HOT DIP GALV.,ASME B16.11,	CPFD40207	
COUPLING		1/2 - 6	3000#	THD	ASTM A105 HOT DIP GALV.,ASME B16.11,	CNFD40207	
ELBOW		1/2 - 6	3000#	THD	ASTM A105 HOT DIP GALV.,ASME B16.11,	ELFD40207	
HALF COUPLING		1/2 - 6	3000#	THD	ASTM A105 HOT DIP GALV.,ASME B16.11,	HFFD40207	
PLUG		1/2 - 1 1/2		THD	ASTM A105 HOT DIP GALV.,ASME B16.11,ROUND HEAD	PGFD40200	
REDUCER CONC.		2 - 6		THD	ASTM A105 HOT DIP GALV.,ASME B16.11,	RCFD40200	
REDUCER ECC.		2 - 6		THD	ASTM A105 HOT DIP GALV.,ASME B16.11,	REFD40200	
TEE		1/2 - 6	3000#	THD	ASTM A105 HOT DIP GALV.,ASME B16.11,	TEFD40207	
THREDOLET		1/2 - 1 1/2	3000#	THD	ASTM A105 HOT DIP GALV.,MSS SP 97,	TLFD43307	
NIPPLE							
NIPPLE		1/2 - 1 1/2		THD	SMLS,ASTM A106 GR.B,HOT DIP GALV.,ASME B36.10,NPT	NPAC41344	
SWAGE NIPPLE							
SWAGE (CONC)		1/2 - 1 1/2		THD	ASTM A105 HOT DIP GALV.,MSS SP 95,	NCFD44500	
SWAGE (ECC)		1/2 - 1 1/2		THD	ASTM A105 HOT DIP GALV.,MSS SP 95,	NEFD44500	
VALVES							
GATE VALVE		2 - 6	150#	FLG	CS BODY ASTM A216 GR WCB,GAV210,	GAV210	
GATE VALVE		1/2 - 1 1/2	800#	THRD	CS BODY ASTM A105,GAV207,	GAV207	
CHECK VALVE		1/2 - 1 1/2	800#	THRD	CS BODY ASTM A105,CHV207,	CHV207	
CHECK VALVE		2 - 6	150#	FLG	CS BODY ASTM A216 GR WCB,CHV210,	CHV210	
BUTTERFLY VALVE		3 - 6	150#	RF	CS BODY ASTM A216 GR WCB,BUV203,LUG TYPE	BUV203	
PLUG VALVE		2 - 6	150#	FLG	CS BODY ASTM A216 GR WCB,PLV202,	PLV202	

Note : 1. Hot Dip Galvanizing shall be done in accordance with ASTM A53 for Pipes & ASTM A153 for flanged & fittings.

2.Surface where Galvanizing has been burnt off during welding etc. shall be wire brushed ,zinc coated or cold galvanized.

**PIPING MATERIAL SPECIFICATION**

CLIENT : M/S..TFL
 PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
 LOCATION : TALCHER,ODISHA

Project :TFL
 DOC. No.TFL-PDS-600
 Rev.:1

Class: B24

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE BD,CWS,CWR,DO,ES,FG,FN,FO,FW,IAW,NI,PA,P G ETC	TEMPERATURE LIMITS (Deg.C)			
	Ref.SI	Ref.SI		
RATING ASME 150# RF	CORROSION ALLOWANCE 1.5 MM(MIN.)	MATERIAL CS		

ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
PIPE							
PIPE		2 - 6	SCH 40	BE	SMLS,API 5L GR.B,ASME B36.10,	PPA111300	
PIPE		8 - 10	SCH 20	BE	ERW,API 5L GR.B,ASME B36.10,	PPA211300	
PIPE		12 - 12	SCH 20	BE	ERW,API 5L GR.B,ASME B36.10,	PPA211300	
PIPE		1/2 - 3/4	SCH 80	PE	SMLS,API 5L GR.B,ASME B36.10,	PPA121300	
PIPE		1 - 1 1/4	SCH 80	PE	SMLS,API 5L GR.B,ASME B36.10,	PPA121300	
PIPE		1 1/2 - 1 1/2	SCH 80	PE	SMLS,API 5L GR.B,ASME B36.10,	PPA121300	
PIPE		14 - 14	SCH 10	BE	ERW,API 5L GR.B,ASME B36.10,	PPA211300	
PIPE		16 - 18	SCH 10	BE	LSAW,API 5L GR.B,ASME B36.10,	PP9611300	
PIPE		20 - 20	SCH 10	BE	LSAW,API 5L GR.B,ASME B36.10,	PP9611300	
PIPE		22 - 24	SCHSTD	BE	LSAW,API 5L GR.B,ASME B36.10,	PP9611300	
PIPE		26 - 28	SCHSTD	BE	LSAW,API 5L GR.B,ASME B36.10,	PP9611300	
PIPE		30 - 32	SCHSTD	BE	LSAW,API 5L GR.B,ASME B36.10,	PP9611300	
PIPE		34 - 34	SCHSTD	BE	LSAW,API 5L GR.B,ASME B36.10,	PP9611300	
PIPE		36 - 38	SCH XS	BE	LSAW,API 5L GR.B,ASME B36.10,	PP9611300	
PIPE		40 - 42	SCH XS	BE	LSAW,API 5L GR.B,ASME B36.10,	PP9611300	
PIPE		44 - 46	SCH XS	BE	LSAW,API 5L GR.B,ASME B36.10,	PP9611300	
PIPE		48 - 48	SCH XS	BE	LSAW,API 5L GR.B,ASME B36.10,	PP9611300	
FLANGE							
FLANGE		1/2 - 24	150#	SO-RF 125 AARH	CS ASTM A105,ASME B16.5,SLIP ON	FL0260801	
LONG W.N.FLANGE		1 1/2 - 1 1/2	300#	WN-RF 125 AARH	CS ASTM A105,ASME B16.5,24mm Bore,200mm Long	LN0270802	
W.N.FLANGE		26 - 48	150#	WN-RF 125 AARH	CS ASTM A105,ASME B16.47 SR.B,WELD NECK	WN0270701	
SPACER AND BLIND		14 - 48	150#	RF 125 AARH	CS ASTM A105,ASME B16.48,	RS022P001	
SPECL BLIND		1/2 - 12	150#	RF 125 AARH	CS ASTM A105,ASME B16.48,	SP022P001	
BLIND FLANGE							
BLIND FLANGE		26 - 48	150#	RF 125 AARH	CS ASTM A105,ASME B16.47 SR.B,	BF0220701	
BLIND FLANGE		1/2 - 24	150#	RF 125 AARH	CS ASTM A105,ASME B16.5,	BF0220801	
GASKET							
GASKET		1/2 - 24	150#	SPRL-WND RF	TP304 SS WDG;GPH FLR;TP304 SS INR RNG;CS OTR RNG,ASME B16.20,	GSQN30301	
GASKET		26 - 48	150#	SPRL-WND RF	TP304 SS WDG;GPH FLR;TP304 SS INR RNG;CS OTR RNG,ASME B16.20/B16.47 SR.B,	GSQN3QJ01	
STUD & NUTS							
STUD & 2NUTS HVY		-			ASTM A193 GR.B7/ASTM A194 GR.2H,,	SNDE00000	
HEX							
DRIP RING							
DRIP RING		3 - 3	150#	RF 125 AARH	CS ASTM A105,PDIL-PDS-600,	DR022QK01	
FITTING (BW)							
BRANCH WELD		2 - 48		BW	CARBON STEEL,ASME B31.3,	RWOJ11200	
BRANCH WELD WITH RP		2 - 48		BW	CARBON STEEL,ASME B31.3,	WBOJ11200	
CAP		2 - 48		BW	ASTM A234 WPB-SMLS,ASME B16.9,	CP7310900	
ELBOW		2 - 6		BW	ASTM A234 WPB-SMLS,ASME B16.9,	EL7310900	
ELBOW		8 - 48		BW	ASTM A234 WPB-WLDD,ASME B16.9,	ELOY10900	L
ELBOW		8 - 48		BW	ASTM A234 WPB-WLDD,PDIL-PDS-600,R=3D	ELOY1QK00	3
ELBOW		8 - 48		BW	ASTM A234 WPB-WLDD,PDIL-PDS-600,R=5D	ELOY1QK00	5
ELBOW		8 - 48		BW	ASTM A234 WPB-WLDD,PDIL-PDS-600,R=7D	ELOY1QK00	7
REDUCER CONC.		2 - 6		BW	ASTM A234 WPB-SMLS,ASME B16.9,	RC7310900	
REDUCER CONC.		8 - 48		BW	ASTM A234 WPB-WLDD,ASME B16.9,	RCOY10900	
REDUCER ECC.		2 - 6		BW	ASTM A234 WPB-SMLS,ASME B16.9,	RE7310900	
REDUCER ECC.		8 - 48		BW	ASTM A234 WPB-WLDD,ASME B16.9,	REOY10900	
TEE		2 - 6		BW	ASTM A234 WPB-SMLS,ASME B16.9,	TE7310900	
TEE		8 - 48		BW	ASTM A234 WPB-WLDD,ASME B16.9,	TEOY10900	



PIPING MATERIAL SPECIFICATION

CLIENT : M/S..TFL
PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
LOCATION : TALCHER,ODISHA

Project :TFL
DOC. No.TFL-PDS-600
Rev.:1

Class: B24

PROJECTS AND DEVELOPMENT INDIA LIMITED

Table with columns: SERVICE (BD,CWS,CWR,DO,ES,FG,FN,FO,FW,IAW,NI,PA,P G ETC), TEMPERATURE LIMITS (Deg.C) (Ref.SI, Ref.SI), RATING ASME (150# RF), CORROSION ALLOWANCE (1.5 MM(MIN.)), MATERIAL (CS)

Main table with columns: ITEM, NOTES, SIZE (NPS), SCH/ RAT, END, DESCRIPTION, COMM CODE, SPLC REV. Includes sections for FITTING (SW), FITTING (THD), NIPPLE, SWAGE NIPPLE, STRAINER, and VALVES.



PIPING MATERIAL SPECIFICATION

CLIENT : M/S..TFL
PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
LOCATION : TALCHER,ODISHA

Project :TFL
DOC. No.TFL-PDS-600
Rev.:0

Class: B24D

PROJECTS AND DEVELOPMENT INDIA LIMITED

Table with columns: SERVICE (WASTE EFFLUENT,HCL), TEMPERATURE LIMITS (Deg.C) (Ref.SI, Ref.SI), RATING ASME (150# FF), CORROSION ALLOWANCE (NONE), MATERIAL (HDPE)

Table with columns: ITEM, NOTES, SIZE (NPS), SCH/ RAT, END, DESCRIPTION, COMM CODE, SPCL REV

PIPE

Table listing pipe specifications: PIPE, SIZE (1-11/4 to 12-12), SCH/RAT (CALC), END (PE), DESCRIPTION (HDPE ASTM D3350 CELL 345464C), COMM CODE (PP5922A00)

FLANGE

Table listing flange specification: FLANGE, SIZE (1-12), SCH/RAT (150#), END (LJ-FF), DESCRIPTION (DI ASTM A536 GR.65-45-12), COMM CODE (FL5193501)

BLIND FLANGE

Table listing blind flange specification: BLIND FLANGE, SIZE (1-12), SCH/RAT (150#), END (FF), DESCRIPTION (CS ASTM A105,ASME B16.5), COMM CODE (BF0210801)

GASKET

Table listing gasket specification: GASKET, SIZE (1-12), SCH/RAT (150#), END (3.0 MM THK FF), DESCRIPTION (EPDM,ASME B16.21), COMM CODE (GS7880401)

STUD & NUTS

Table listing stud & nuts specification: STUD & 2NUTS HVY, SIZE (-), SCH/RAT (-), END (-), DESCRIPTION (A307 GR.B/A563 GR.B,,), COMM CODE (SN3B00000)

HEX

FITTING

Table listing fitting specifications: ELBOW, REDUCER CONC., REDUCER ECC., STUB END, TEE, SIZE (1-12), SCH/RAT (150#), END (PE), DESCRIPTION (HDPE ASTM D3350 CELL 345464C), COMM CODE (EL59J2B00 to TE59J2B00)

VALVES

Table listing valve specifications: CHECK VALVE, BALL VALVE, BUTTERFLY VALVE, SIZE (1-12), SCH/RAT (150#), END (FLG, FF), DESCRIPTION (CS BODY ASTM A216 GR.WCB RUBBER LINED, CHV210D, SS BODY ASTM A351 GR CF8M, BAV510, CS BODY ASTM A216 GR.WCB RUBBER LINED, BUV203F, LUG TYPE), COMM CODE (CHV210D, BAV510, BUV203F)

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PIPING MATERIAL SPECIFICATION

CLIENT : M/S..TFL
 PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
 LOCATION : TALCHER,ODISHA

Project :TFL
 DOC. No.TFL-PDS-600
 Rev.:0

Class: B24FL

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE EFFLUENT,ACIDIC H2O ETC.	TEMPERATURE LIMITS (Deg.C)			
	Ref.SI	Ref.SI		
RATING ASME 150# FF	CORROSION ALLOWANCE NONE	MATERIAL CS FRP LND.		

ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
PIPE							
PIPE		1 - 11/4	SCH XS	FLGD	CS,SMLS,API 5L GR.B,FRP LND.,ASME B36.10,THK OF LING AS PER MFR.	PP5661300	
PIPE		1 1/2 - 11/2	SCH XS	FLGD	CS,SMLS,API 5L GR.B,FRP LND.,ASME B36.10,THK OF LING AS PER MFR.	PP5661300	
PIPE		2 - 21/2	SCHSTD	FLGD	CS,SMLS,API 5L GR.B,FRP LND.,ASME B36.10,THK OF LING AS PER MFR.	PP5661300	
PIPE		3 - 4	SCHSTD	FLGD	CS,SMLS,API 5L GR.B,FRP LND.,ASME B36.10,THK OF LING AS PER MFR.	PP5661300	
PIPE		5 - 6	SCHSTD	FLGD	CS,SMLS,API 5L GR.B,FRP LND.,ASME B36.10,THK OF LING AS PER MFR.	PP5661300	
PIPE		8 - 10	SCH 20	FLGD	CS,ERW,API 5L GR.B,FRP LND,ASME B36.10,THK OF LING AS PER MFR.	PP5761300	
PIPE		12 - 12	SCH 20	FLGD	CS,ERW,API 5L GR.B,FRP LND,ASME B36.10,THK OF LING AS PER MFR.	PP5761300	
FLANGE							
FLANGE		1 - 2	150#	SO-FF	CS,ASTM A105,FRP LND.,ASME B16.5,THK OF LING AS PER MFR.	FL5850801	
W.N.FLANGE		1 - 12	150#	WN-FF	CS,ASTM A105,FRP LND.,ASME B16.5,THK OF LING AS PER MFR.	WN58M0801	
SPECL BLIND		1 - 12	150#	FF	CS PLT,ASTM A516 GR.60,FRP LND.,ASME B16.48,THK OF LING AS PER MFR.	SP641P001	
BLIND FLANGE							
BLIND FLANGE		1 - 12	150#	FF	CS,ASTM A105,FRP LND.,ASME B16.5,THK OF LING AS PER MFR.	BF5810801	
GASKET							
GASKET		1 - 12	150#	FLAT	GASKET,SOFT RUBBER,ASME B16.21,3MM THK.	GSW190401	
STUD & NUTS							
STUD & 2NUTS HVY HEX		-			ASTM A193 GR.B7/ASTM A194 GR.2H,,	SNDE00000	
FITTING							
ELBOW		1 - 6		FLGD	CS,ASTM A234 WPB-SMLS,FRP LND,ASME B16.9,THK OF LING AS PER MFR.	EL62Z0900	
ELBOW		8 - 12		FLGD	CS,ASTM A234 WPB-WLDD,FRP LND.,ASME B16.9,THK OF LING AS PER MFR.	EL63Z0900	
REDUCER CONC.		1 - 6		FLGD	CS,ASTM A234 WPB-SMLS,FRP LND,ASME B16.9,THK OF LING AS PER MFR.	RC62Z0900	
REDUCER CONC.		8 - 12		FLGD	CS,ASTM A234 WPB-WLDD,FRP LND.,ASME B16.9,THK OF LING AS PER MFR.	RC63Z0900	
REDUCER ECC.		1 - 6		FLGD	CS,ASTM A234 WPB-SMLS,FRP LND,ASME B16.9,THK OF LING AS PER MFR.	RE62Z0900	
REDUCER ECC.		8 - 12		FLGD	CS,ASTM A234 WPB-WLDD,FRP LND.,ASME B16.9,THK OF LING AS PER MFR.	RE63Z0900	
TEE		1 - 6		FLGD	CS,ASTM A234 WPB-SMLS,FRP LND,ASME B16.9,THK OF LING AS PER MFR.	TE62Z0900	
TEE		8 - 12		FLGD	CS,ASTM A234 WPB-WLDD,FRP LND.,ASME B16.9,THK OF LING AS PER MFR.	TE63Z0900	
VALVES							
GATE VALVE		2 - 12	150#	FLG	SS BODY ASTM A351 GR CF8,GAV510,	GAV510	
GLOBE VALVE		2 - 12	150#	FLG	SS BODY ASTM A351 GR CF8,GLV510,	GLV510	
CHECK VALVE		2 - 12	150#	FLG	CS BODY ASTM A216 GR.WCB RUBBER LINED,CHV210D,	CHV210D	
BALL VALVE		2 - 12	150#	FLG	SS BODY ASTM A351 GR CF8M,BAV510,	BAV510	
BUTTERFLY VALVE		2 - 12	150#	FF	CS BODY ASTM A216 GR.WCB RUBBER LINED,BUV203,LUG TYPE	BUV203	

NOTE: 1. S.O. Flanges shall be used with pipe spools.
 2. All fittings shall have ends connected to flanges.

**PIPING MATERIAL SPECIFICATION**

CLIENT : M/S..TFL
 PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
 LOCATION : TALCHER,ODISHA

Project :TFL
 DOC. No.TFL-PDS-600
 Rev.:0

Class: B24G

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE FW	TEMPERATURE LIMITS (Deg.C)			
	Ref.SI	Ref.SI		
RATING ASME 150#	CORROSION ALLOWANCE 1.5 MM(MIN.)	MATERIAL CS(GALVANIZED)		

ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
PIPE							
PIPE		1/2 - 3/4	SCH 80	THD	SMLS,API 5L GR.B,HOT DIP GALV.,ASME B36.10,	PPW231300	
PIPE		1 - 1 1/4	SCH 80	THD	SMLS,API 5L GR.B,HOT DIP GALV.,ASME B36.10,	PPW231300	
PIPE		1 1/2 - 2	SCH 80	THD	SMLS,API 5L GR.B,HOT DIP GALV.,ASME B36.10,	PPW231300	
PIPE		2 1/2 - 3	SCH 40	THD	SMLS,API 5L GR.B,HOT DIP GALV.,ASME B36.10,	PPW231300	
PIPE		4 - 4	SCH 40	THD	SMLS,API 5L GR.B,HOT DIP GALV.,ASME B36.10,	PPW231300	
PIPE		6 - 6	SCH 40	BE	SMLS,API 5L GR.B,HOT DIP GALV.,ASME B36.10,	PPW211300	
FLANGE							
FLANGE		1/2 - 4	150#	THD-RF 125 AARH	ASTM A105 HOT DIP GALV.,ASME B16.5,	FLFDK0801	
W.N.FLANGE		6 - 6	150#	WN-RF 125 AARH	ASTM A105 HOT DIP GALV.,ASME B16.5,	WNFD70801	
SPECL BLIND		1/2 - 6	150#	RF 125 AARH	ASTM A105 HOT DIP GALV.,ASME B16.48,	SPFD2P001	
BLIND FLANGE							
BLIND FLANGE		1/2 - 6	150#	RF 125 AARH	ASTM A105 HOT DIP GALV.,ASME B16.5,	BFFD20801	
GASKET							
GASKET		6 - 6	150#	SPRL-WND RF	TP304 SS WDG;GPH FLR;TP304 SS INR RNG;CS OTR RNG,ASME B16.20,	GSQN30301	
GASKET		1/2 - 4	150#	3.0 MM THK RF	BUTYL RUBBER,ASME B16.21,	GS6720401	
STUD & NUTS							
STUD & 2NUTS HVY		-			ASTM A193GR.B7/A194GR.2H,HOT DIP GALV.,,	SNZC00000	
HEX							
FITTING (BW)							
CAP		6 - 6		BW	ASTM A234 WPB-SMLS,HOT DIP GALV.,ASME B16.9,	CPPD10900	
ELBOW		6 - 6		BW	ASTM A234 WPB-SMLS,HOT DIP GALV.,ASME B16.9,	ELPD10900	
REDUCER CONC.		6 - 6		BW	ASTM A234 WPB-SMLS,HOT DIP GALV.,ASME B16.9,	RCPD10900	
REDUCER ECC.		6 - 6		BW	ASTM A234 WPB-SMLS,HOT DIP GALV.,ASME B16.9,	REPD10900	
TEE		6 - 6		BW	ASTM A234 WPB-SMLS,HOT DIP GALV.,ASME B16.9,	TEPD10900	
FITTING (THD)							
CAP		1/2 - 4	3000#	THD	ASTM A105 HOT DIP GALV.,ASME B16.11,	CPFD40207	
COUPLING		1/2 - 1 1/2	3000#	THD	ASTM A105 HOT DIP GALV.,ASME B16.11,	CNFD40207	
ELBOW		1/2 - 4	3000#	THD	ASTM A105 HOT DIP GALV.,ASME B16.11,	ELFD40207	
PLUG		1/2 - 1 1/2		THD	ASTM A105 HOT DIP GALV.,ASME B16.11,ROUND HEAD	PGFD40200	
REDUCER CONC.		1/2 - 4	3000#	THD	ASTM A105 HOT DIP GALV.,ASME B16.11,	RCFD40207	
REDUCER ECC.		1/2 - 4	3000#	THD	ASTM A105 HOT DIP GALV.,ASME B16.11,	REFD40207	
TEE		1/2 - 4	3000#	THD	ASTM A105 HOT DIP GALV.,ASME B16.11,	TEFD40207	
THREDOLET		1/2 - 1 1/2	3000#	THD	ASTM A105 HOT DIP GALV.,MSS SP 97,	TLFD43307	
NIPPLE							
NIPPLE		1/2 - 6	SCH160	THD	SMLS,API 5L GR.B,HOT DIP GALV.,ASME B36.10,NPT	NPW241312	
SWAGE NIPPLE							
SWAGE (CONC)		1/2 - 1 1/2		THD	ASTM A234 WPB-SMLS,HOT DIP GALV.,MSS SP 95,	NCPD44500	
SWAGE (ECC)		1/2 - 1 1/2		THD	ASTM A234 WPB-SMLS,HOT DIP GALV.,MSS SP 95,	NEPD44500	
VALVES							
GATE VALVE		2 - 6	150#	FLG	CS BODY ASTM A216 GR WCB,GAV210,	GAV210	
GATE VALVE		1/2 - 1 1/2	800#	THRD	CS BODY ASTM A105,GAV207,	GAV207	
CHECK VALVE		1/2 - 1 1/2	800#	THRD	CS BODY ASTM A105,CHV207,	CHV207	
CHECK VALVE		2 - 6	150#	FLG	CS BODY ASTM A216 GR WCB,CHV210,	CHV210	

Note : 1. Hot Dip Galvanizing shall be done in accordance with ASTM A53 for Pipes & ASTM A153 for flanged & fittings.

2.Surface where Galvanizing has been burnt off during welding etc. shall be wire brushed ,zinc coated or cold galvanized.

**PIPING MATERIAL SPECIFICATION**

CLIENT : M/S..TFL
 PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
 LOCATION : TALCHER,ODISHA

Project :TFL
 DOC. No.TFL-PDS-600
 Rev.:0

Class: B24P

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE ETP	TEMPERATURE LIMITS (Deg.C)			
	Ref.SI	Ref.SI		
RATING ASME 150# FF	CORROSION ALLOWANCE NONE	MATERIAL CPVC		

ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
PIPE							
PIPE		2 - 3	SCH 80	PE	CPVC,ASTM F441,MF.STD/ASTM F441,PLASTIC PIPE	PP552QC00	
PIPE		4 - 6	SCH 80	PE	CPVC,ASTM F441,MF.STD/ASTM F441,PLASTIC PIPE	PP552QC00	
PIPE		8 - 10	SCH 80	PE	CPVC,ASTM F441,MF.STD/ASTM F441,PLASTIC PIPE	PP552QC00	
PIPE		12 - 12	SCH 80	PE	CPVC,ASTM F441,MF.STD/ASTM F441,PLASTIC PIPE	PP552QC00	
PIPE		1/2 - 3/4	SCH 80	PE	CPVC,ASTM F441,MF.STD/ASTM F441,PLASTIC PIPE	PP552QC00	
PIPE		1 - 1 1/2	SCH 80	PE	CPVC,ASTM F441,MF.STD/ASTM F441,PLASTIC PIPE	PP552QC00	
FLANGE							
FLANGE		1/2 - 12	150#	FF	CPVC,ASTM F441,MF.STD/ASTM F441,SCH80	FL551QC01	
BLIND FLANGE							
BLIND FLANGE		1/2 - 12	150#	FF	CPVC,ASTM F441,MF.STD/ASTM F441,	BF551QC01	
GASKET							
GASKET		1/2 - 12	150#	3.0 MM THK FF	EPDM,MF.STD./ASME B16.21,FULL FACE	GS788PA01	
STUD & NUTS							
STUD & 2NUTS HVY		-			ASTM A193 GR.B7/ASTM A194 GR.2H,,	SNDE00000	
HEX							
FITTING (BW)							
BRANCH WELD WITH RP		1/2 - 12		PE	CPVC,ASTM F441,MF.STD/ASTM F441,	WB55JQC00	
FITTING (THD)							
CAP		1/2 - 1 1/2	3000#	THD	CPVC,ASTM F441,MF.STD/ASTM F441,	CP554QC07	
FITTING							
ELBOW		1/2 - 12		PE	CPVC,ASTM F441,MF.STD/ASTM F441,	EL55JQC00	
REDUCER CONC.		1/2 - 12		PE	CPVC,ASTM F441,MF.STD/ASTM F441,	RC55JQC00	
REDUCER ECC.		1/2 - 12		PE	CPVC,ASTM F441,MF.STD/ASTM F441,	RE55JQC00	
TEE		1/2 - 12		PE	CPVC,ASTM F441,MF.STD/ASTM F441,	TE55JQC00	
UNION (GJ)		1/2 - 12		PE	CPVC,ASTM F441,MF.STD/ASTM F441,	UN55JQC00	
NIPPLE							
NIPPLE		1/2 - 1 1/2	SCH160	PLN-PLN	CPVC,ASTM F441,MF.STD/ASTM F441,	NP555QC12	1
NIPPLE		1/2 - 1 1/2	SCH160	PLN-THD	CPVC,ASTM F441,MF.STD/ASTM F441,PLASTIC PIPE NPT	NP556QC12	2
NIPPLE		1/2 - 1 1/2	SCH160	THD	CPVC,ASTM F441,MF.STD/ASTM F441,PLASTIC PIPE NPT	NP554QC12	3
VALVES							
GATE VALVE		1/2 - 12	150#	FF	CPVC BODY W/ PP PLUG & EPDM SEATS,GAV500C,	GAV500C	
CHECK VALVE		1/2 - 12	150#	FF	CPVC BODY,CHV500C,	CHV500C	
BALL VALVE		1/2 - 2	150#	FF	CPVC BODY WITH CPVC BALL,BAV500C,	BAV500C	
BALL VALVE		3 - 6	150#	FF	CPVC BODY WITH CPVC BALL,BAV501C,	BAV501C	

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**PIPING MATERIAL SPECIFICATION**

CLIENT : M/S..TFL
 PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
 LOCATION : TALCHER,ODISHA

Project ..TFL
 DOC. No.TFL-PDS-600
 Rev.:0

Class: B24RL

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE EFFLUENT,WASTE H2O,CHLORINATED H2O	TEMPERATURE LIMITS (Deg.C)			
	Ref.SI	Ref.SI		
RATING ASME 150# FF	CORROSION ALLOWANCE 1.5 MM(MIN.)	MATERIAL CSRL		

ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
PIPE							
PIPE		1/2 - 3/4	SCH 80	FLGD	CS,SMLS,API 5L GR.B,NATURAL RBR LND,ASME B36.10,3MM THK LING	PPX761300	
PIPE		1 - 1 1/4	SCH 80	FLGD	CS,SMLS,API 5L GR.B,NATURAL RBR LND,ASME B36.10,3MM THK LING	PPX761300	
PIPE		1 1/2 - 1 1/2	SCH 80	FLGD	CS,SMLS,API 5L GR.B,NATURAL RBR LND,ASME B36.10,3MM THK LING	PPX761300	
PIPE		2 - 2 1/2	SCH 40	FLGD	CS,SMLS,API 5L GR.B,NATURAL RBR LND,ASME B36.10,3MM THK LING	PPX761300	
PIPE		3 - 4	SCHSTD	FLGD	CS,SMLS,API 5L GR.B,NATURAL RBR LND,ASME B36.10,3MM THK LING	PPX761300	
PIPE		5 - 6	SCHSTD	FLGD	CS,SMLS,API 5L GR.B,NATURAL RBR LND,ASME B36.10,3MM THK LING	PPX761300	
PIPE		8 - 10	SCHSTD	FLGD	CS,ERW,API 5L GR.B,NATURAL RBR LND,ASME B36.10,3MM THK LING	PP2A61300	
PIPE		12 - 12	SCHSTD	FLGD	CS,ERW,API 5L GR.B,NATURAL RBR LND,ASME B36.10,3MM THK LING	PP2A61300	
FLANGE							
FLANGE		1/2 - 12	150#	SO-FF	CS,ASTM A105,NATURAL RBR LND,ASME B16.5,3MM THK LING	FLX650801	
SPECL BLIND		1 - 12	150#	FF	CS PLT,ASTM A516 GR.60,NATURAL RBR LND,ASME B16.48,3MM THK LING	SPX81P001	
BLIND FLANGE							
BLIND FLANGE		1 - 12	150#	FF	CS,ASTM A105,NATURAL RBR LND,ASME B16.5,3MM THK LING	BFX610801	
GASKET							
GASKET		1 - 12	150#	FLAT	GASKET,SOFT RUBBER,ASME B16.21,3MM THK.	GSW190401	
STUD & NUTS							
STUD & 2NUTS HVY HEX		-			ASTM A193 GR.B7/ASTM A194 GR.2H,,	SNDE00000	
FITTING							
DIAPH. VALVE		1 - 12	150#	FLG	CS BODY ASTM A216 GR.WCB RUBBER LINED,DPV500,	DPV500	
ELBOW		1/2 - 6		FLGD	CS,ASTM A234 WPB-SMLS,NATURAL RBR LND,ASME B16.9,3MM THK LING	ELX9Z0900	
ELBOW		8 - 12		FLGD	CS,ASTM A234 WPB-WLDD,NATURAL RBR LND,ASME B16.9,3MM THK LING	EL3AZ0900	
REDUCER CONC.		1/2 - 6		FLGD	CS,ASTM A234 WPB-SMLS,NATURAL RBR LND,ASME B16.9,3MM THK LING	RCX9Z0900	
REDUCER CONC.		8 - 12		FLGD	CS,ASTM A234 WPB-WLDD,NATURAL RBR LND,ASME B16.9,3MM THK LING	RC3AZ0900	
REDUCER ECC.		1/2 - 6		FLGD	CS,ASTM A234 WPB-SMLS,NATURAL RBR LND,ASME B16.9,3MM THK LING	REX9Z0900	
REDUCER ECC.		8 - 12		FLGD	CS,ASTM A234 WPB-WLDD,NATURAL RBR LND,ASME B16.9,3MM THK LING	RE3AZ0900	
TEE		1/2 - 6		FLGD	CS,ASTM A234 WPB-SMLS,NATURAL RBR LND,ASME B16.9,3MM THK LING	TEX9Z0900	
TEE		8 - 12		FLGD	CS,ASTM A234 WPB-WLDD,NATURAL RBR LND,ASME B16.9,3MM THK LING	TE3AZ0900	
VALVES							
GATE VALVE		1/2 - 12	150#	FLG	SS BODY ASTM A351 GR CF8,GAV510,	GAV510	
GLOBE VALVE		1/2 - 12	150#	FLG	SS BODY ASTM A351 GR CF8,GLV510,	GLV510	
CHECK VALVE		2 - 12	150#	FLG	CS BODY ASTM A216 GR.WCB RUBBER LINED,CHV210D,	CHV210D	
BALL VALVE		2 - 12	150#	FLG	SS BODY ASTM A351 GR CF8M,BAV510,	BAV510	
BUTTERFLY VALVE		2 - 12	150#	FF	CS BODY ASTM A216 GR.WCB RUBBER LINED,BUV203RL,LUG TYPE	BUV203RL	

NOTE: 1. S.O. Flanges shall be used with pipe spools.
 2. All fittings shall have ends connected to flanges.

**PIPING MATERIAL SPECIFICATION**

CLIENT : M/S..TFL
 PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
 LOCATION : TALCHER,ODISHA

Project :TFL
 DOC. No.TFL-PDS-600
 Rev.:0

Class: B24S

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE SL,SC (IBR)	TEMPERATURE LIMITS (Deg.C)						
	Ref.SI	Ref.SI					
RATING ASME 150# RF	CORROSION ALLOWANCE 1.5 MM(MIN.)	MATERIAL CS					
ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
PIPE							
PIPE		2 - 6	SCH 40	BE IBR	SMLS,ASTM A106 GR.B,ASME B36.10,	PP03A1300	
PIPE		8 - 10	SCH 20	BE IBR	SMLS,ASTM A106 GR.B,ASME B36.10,	PP03A1300	
PIPE		12 - 12	SCH 20	BE IBR	SMLS,ASTM A106 GR.B,ASME B36.10,	PP03A1300	
PIPE		1/2 - 3/4	SCH 80	PE IBR	SMLS,ASTM A106 GR.B,ASME B36.10,	PP03B1300	
PIPE		1 - 1 1/4	SCH 80	PE IBR	SMLS,ASTM A106 GR.B,ASME B36.10,	PP03B1300	
PIPE		1 1/2 - 1 1/2	SCH 80	PE IBR	SMLS,ASTM A106 GR.B,ASME B36.10,	PP03B1300	
PIPE		14 - 16	SCH 10	BE IBR	SMLS,ASTM A106 GR.B,ASME B36.10,	PP03A1300	
PIPE		18 - 20	SCH 10	BE IBR	SMLS,ASTM A106 GR.B,ASME B36.10,	PP03A1300	
PIPE		24 - 24	SCHSTD	BE IBR	SMLS,ASTM A106 GR.B,ASME B36.10,	PP03A1300	
PIPE		26 - 28	SCHSTD	BE IBR	EFW,ASTM A671 GR.CC60 CL.22,ASME B36.10,	PPRXA1300	
PIPE		30 - 32	SCHSTD	BE IBR	EFW,ASTM A671 GR.CC60 CL.22,ASME B36.10,	PPRXA1300	
PIPE		34 - 34	SCHSTD	BE IBR	EFW,ASTM A671 GR.CC60 CL.22,ASME B36.10,	PPRXA1300	
PIPE		36 - 38	SCH XS	BE IBR	EFW,ASTM A671 GR.CC60 CL.22,ASME B36.10,	PPRXA1300	
PIPE		40 - 42	SCH XS	BE IBR	EFW,ASTM A671 GR.CC60 CL.22,ASME B36.10,	PPRXA1300	
PIPE		44 - 46	SCH XS	BE IBR	EFW,ASTM A671 GR.CC60 CL.22,ASME B36.10,	PPRXA1300	
PIPE		48 - 48	14.27 MM	BE IBR	EFW,ASTM A671 GR.CC60 CL.22,ASME B36.10,	PPRXA1300	
FLANGE							
FLANGE		1/2 - 24	150#	SO-RF 125 AARH IBR	CS ASTM A105,ASME B16.5,SLIP ON	FL02F0801	
W.N.FLANGE		26 - 48	150#	WN-RF 125 AARH IBR	CS ASTM A105,ASME B16.47 SR.B,WELD NECK	WN02G0701	
SPACER AND BLIND		14 - 24	150#	RF 125 AARH IBR	CS ASTM A105,ASME B16.48,	RS02BPO01	
SPECL BLIND		1/2 - 12	150#	RF 125 AARH IBR	CS ASTM A105,ASME B16.48,	SP02BPO01	
BLIND FLANGE							
BLIND FLANGE		26 - 48	150#	RF 125 AARH IBR	CS ASTM A105,ASME B16.47 SR.B,	BF02B0701	
BLIND FLANGE		1/2 - 24	150#	RF 125 AARH IBR	CS ASTM A105,ASME B16.5,	BF02B0801	
GASKET							
GASKET		1/2 - 24	150#	SPRL-WND RF	TP304 SS WDG;GPH FLR;TP304 SS INR RNG;CS OTR RNG,ASME B16.20,	GSQN30301	
GASKET		26 - 48	150#	SPRL-WND RF	TP304 SS WDG;GPH FLR;TP304 SS INR RNG;CS OTR RNG,ASME B16.20/B16.47 SR.B,	GSQN3QJ01	
STUD & NUTS							
STUD & 2NUTS HVY HEX		-			ASTM A193 GR.B7/ASTM A194 GR.2H,,	SNDE00000	
FITTING (BW)							
BRANCH WELD		2 - 48		BW IBR	CARBON STEEL,ASME B31.3,	RWOJA1200	
BRANCH WELD WITH RP		2 - 48		BW IBR	CARBON STEEL,ASME B31.3,	WBOJA1200	
CAP		2 - 48		BW IBR	ASTM A234 WPB-SMLS,ASME B16.9,	CP73A0900	
ELBOW		2 - 24		BW IBR	ASTM A234 WPB-SMLS,ASME B16.9,	EL73A0900	
ELBOW		26 - 48		BW IBR	ASTM A234 WPB-WLDD,ASME B16.9,	ELOYA0900	
REDUCER CONC.		2 - 24		BW IBR	ASTM A234 WPB-SMLS,ASME B16.9,	RC73A0900	
REDUCER CONC.		26 - 48		BW IBR	ASTM A234 WPB-WLDD,ASME B16.9,	RCOYA0900	
REDUCER ECC.		2 - 24		BW IBR	ASTM A234 WPB-SMLS,ASME B16.9,	RE73A0900	
REDUCER ECC.		26 - 48		BW IBR	ASTM A234 WPB-WLDD,ASME B16.9,	REOYA0900	
TEE		2 - 24		BW IBR	ASTM A234 WPB-SMLS,ASME B16.9,	TE73A0900	
TEE		26 - 48		BW IBR	ASTM A234 WPB-WLDD,ASME B16.9,	TEOYA0900	
WELDOLET		2 - 48		BW IBR	CS ASTM A105,MSS SP 97,	WL02A3300	
FITTING (SW)							
CAP		1/2 - 1 1/2	3000#	SOCW IBR	CS ASTM A105,ASME B16.11,	CP02C0207	W
COUPLING		1/2 - 1 1/2	3000#	SOCW IBR	CS ASTM A105,ASME B16.11,	CN02C0207	



PIPING MATERIAL SPECIFICATION

CLIENT : M/S..TFL
PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
LOCATION : TALCHER,ODISHA

Project :TFL
DOC. No.TFL-PDS-600
Rev.:0

Class: B24S

PROJECTS AND DEVELOPMENT INDIA LIMITED

Table with columns: SERVICE SL.SC (IBR), TEMPERATURE LIMITS (Deg.C) (Ref.SI), RATING ASME (150# RF), CORROSION ALLOWANCE (1.5 MM(MIN.)), MATERIAL (CS)

Main table with columns: ITEM, NOTES, SIZE (NPS), SCH/ RAT, END, DESCRIPTION, COMM CODE, SPCL REV. Includes sections for FITTING (THD), NIPPLE, SWAGE NIPPLE, and VALVES.

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**PIPING MATERIAL SPECIFICATION**

CLIENT : M/S..TFL
 PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
 LOCATION : TALCHER,ODISHA

Project :TFL
 DOC. No.TFL-PDS-600
 Rev.:1

Class: B24Z

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE FLARE		TEMPERATURE LIMITS (Deg.C)					
		Ref.SI	Ref.SI				
RATING ASME	CORROSION ALLOWANCE	MATERIAL					
150# RF	3.0 MM(MIN.)	CS					
ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
PIPE							
PIPE		2 - 2	SCH 80	BE	SMLS,API 5L GR.B,ASME B36.10,	PPA111300	
PIPE		2 1/2 - 3	SCHSTD	BE	SMLS,API 5L GR.B,ASME B36.10,	PPA111300	
PIPE		4 - 5	SCHSTD	BE	SMLS,API 5L GR.B,ASME B36.10,	PPA111300	
PIPE		6 - 6	SCHSTD	BE	SMLS,API 5L GR.B,ASME B36.10,	PPA111300	
PIPE		8 - 10	SCHSTD	BE	ERW,API 5L GR.B,ASME B36.10,	PPA211300	
PIPE		12 - 14	SCHSTD	BE	ERW,API 5L GR.B,ASME B36.10,	PPA211300	
PIPE		1/2 - 3/4	SCH160	PE	SMLS,API 5L GR.B,ASME B36.10,	PPA121300	
PIPE		1 - 1 1/4	SCH160	PE	SMLS,API 5L GR.B,ASME B36.10,	PPA121300	
PIPE		1 1/2 - 1 1/2	SCH160	PE	SMLS,API 5L GR.B,ASME B36.10,	PPA121300	
PIPE		16 - 18	SCHSTD	BE	LSAW,API 5L GR.B,ASME B36.10,	PP9611300	
PIPE		20 - 22	SCHSTD	BE	LSAW,API 5L GR.B,ASME B36.10,	PP9611300	
PIPE		24 - 24	SCHSTD	BE	LSAW,API 5L GR.B,ASME B36.10,	PP9611300	
FLANGE							
FLANGE		1/2 - 24	150#	SO-RF 125 AARH	CS ASTM A105,ASME B16.5,SLIP ON	FL0260801	
LONG W.N.FLANGE		1 1/2 - 1 1/2	300#	WN-RF 125 AARH	CS ASTM A105,ASME B16.5,24mm Bore,200mm Long	LN0270802	
W.N.FLANGE		26 - 48	150#	WN-RF 125 AARH	CS ASTM A105,ASME B16.47 SR.B,WELD NECK	WN0270701	
SPACER AND BLIND		14 - 48	150#	RF 125 AARH	CS ASTM A105,ASME B16.48,	RS022P001	
SPECL BLIND		1/2 - 12	150#	RF 125 AARH	CS ASTM A105,ASME B16.48,	SP022P001	
BLIND FLANGE							
BLIND FLANGE		26 - 48	150#	RF 125 AARH	CS ASTM A105,ASME B16.47 SR.B,	BF0220701	
BLIND FLANGE		1/2 - 24	150#	RF 125 AARH	CS ASTM A105,ASME B16.5,	BF0220801	
GASKET							
GASKET		1/2 - 24	150#	SPRL-WND RF	TP304 SS WDG;GPH FLR;TP304 SS INR RNG;CS OTR RNG,ASME B16.20,	GSQN30301	
GASKET		26 - 48	150#	SPRL-WND RF	TP304 SS WDG;GPH FLR;TP304 SS INR RNG;CS OTR RNG,ASME B16.20/B16.47 SR.B,	GSQN3QJ01	
STUD & NUTS							
STUD & 2NUTS HVY		-			ASTM A193 GR.B7/ASTM A194 GR.2H,,	SNDE00000	
HEX							
DRIP RING							
DRIP RING		3 - 3	150#	RF 125 AARH	CS ASTM A105,PDIL-PDS-600,	DR022QK01	
FITTING (BW)							
BRANCH WELD		2 - 48		BW	CARBON STEEL,ASME B31.3,	RWOJ11200	
BRANCH WELD WITH RP		2 - 48		BW	CARBON STEEL,ASME B31.3,	WBOJ11200	
CAP		2 - 48		BW	ASTM A234 WPB-SMLS,ASME B16.9,	CP7310900	
ELBOW		2 - 6		BW	ASTM A234 WPB-SMLS,ASME B16.9,	EL7310900	
ELBOW		8 - 48		BW	ASTM A234 WPB-WLDD,ASME B16.9,	ELOY10900	L
ELBOW		8 - 48		BW	ASTM A234 WPB-WLDD,PDIL-PDS-600,R=3D	ELOY1QK00	3
ELBOW		8 - 48		BW	ASTM A234 WPB-WLDD,PDIL-PDS-600,R=5D	ELOY1QK00	5
ELBOW		8 - 48		BW	ASTM A234 WPB-WLDD,PDIL-PDS-600,R=7D	ELOY1QK00	7
REDUCER CONC.		2 - 6		BW	ASTM A234 WPB-SMLS,ASME B16.9,	RC7310900	
REDUCER CONC.		8 - 48		BW	ASTM A234 WPB-WLDD,ASME B16.9,	RCOY10900	
REDUCER ECC.		2 - 6		BW	ASTM A234 WPB-SMLS,ASME B16.9,	RE7310900	
REDUCER ECC.		8 - 48		BW	ASTM A234 WPB-WLDD,ASME B16.9,	REOY10900	
TEE		2 - 6		BW	ASTM A234 WPB-SMLS,ASME B16.9,	TE7310900	
TEE		8 - 48		BW	ASTM A234 WPB-WLDD,ASME B16.9,	TEOY10900	
WELDOLET		2 - 48		BW	CS ASTM A105,MSS SP 97,	WL0213300	
FITTING (SW)							
CAP		1/2 - 1 1/2	3000#	SOCW	CS ASTM A105,ASME B16.11,	CP0230207	W
COUPLING		1/2 - 1 1/2	3000#	SOCW	CS ASTM A105,ASME B16.11,	CN0230207	W
ELBOW		1/2 - 1 1/2	3000#	SOCW	CS ASTM A105,ASME B16.11,	EL0230207	

**PIPING MATERIAL SPECIFICATION**

CLIENT : M/S..TFL
 PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
 LOCATION : TALCHER,ODISHA

Project :TFL
 DOC. No.TFL-PDS-600
 Rev.:1

Class: B24Z

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE FLARE	TEMPERATURE LIMITS (Deg.C)			
	Ref.SI	Ref.SI		
RATING ASME 150# RF	CORROSION ALLOWANCE 3.0 MM(MIN.)	MATERIAL CS		

ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
HALF COUPLING		1/2 - 1 1/2	3000#	SOCW	CS ASTM A105,ASME B16.11,	HF0230207	
SOCKOLET		1/2 - 48	3000#	SOCW	CS ASTM A105,MSS SP 97,	SL0233307	
TEE		1/2 - 1 1/2	3000#	SOCW	CS ASTM A105,ASME B16.11,	TE0230207	
FITTING (THD)							
CAP		1/2 - 1 1/2	3000#	THD	CS ASTM A105,ASME B16.11,	CP0240207	T
COUPLING		1/2 - 1 1/2	3000#	THD	CS ASTM A105,ASME B16.11,	CN0240207	T
PLUG		1/2 - 1 1/2		THD	CS ASTM A105,ASME B16.11,ROUND HEAD	PG0240200	
THREDOLET		1/2 - 48	3000#	THD	CS ASTM A105,MSS SP 97,	TL0243307	
NIPPLE							
NIPPLE		1/2 - 1 1/2	SCH160	PLN-PLN	SMLS,API 5L GR.B,ASME B36.10,	NPA151312	1
NIPPLE		1/2 - 1 1/2	SCH160	PLN-THD	SMLS,API 5L GR.B,ASME B36.10,NPT	NPA161312	2
NIPPLE		1/2 - 1 1/2	SCH160	THD	SMLS,API 5L GR.B,ASME B36.10,NPT	NPA141312	3
SWAGE NIPPLE							
SWAGE (CONC)		1/2 - 1 1/2		PE	ASTM A234 WPB-SMLS,MSS SP 95,	NC73J4500	P
SWAGE (CONC)		1/2 - 1 1/2		PLN-THD	ASTM A234 WPB-SMLS,MSS SP 95,	NC7364500	T
SWAGE (ECC)		1/2 - 1 1/2		PE	ASTM A234 WPB-SMLS,MSS SP 95,	NE73J4500	P
SWAGE (ECC)		1/2 - 1 1/2		PLN-THD	ASTM A234 WPB-SMLS,MSS SP 95,	NE7364500	T
STRAINER							
T-TYPE STRAINER		2 - 24	150#	FLGD	CS ASTM A216 GR WCB,TTS210,	TTS210	
Y-TYPE STRAINER		1/2 - 1 1/2	600#	SOCW	CS ASTM A105,YTS201,	YTS201	
Y-TYPE STRAINER		2 - 24	150#	FLGD	CS ASTM A216 GR WCB,YTS210,	YTS210	
VALVES							
GATE VALVE		1/2 - 1 1/2	800#	SOCW	CS BODY ASTM A105,GAV201,	GAV201	
GATE VALVE		2 - 48	150#	FLG	CS BODY ASTM A216 GR WCB,GAV210,	GAV210	
GLOBE VALVE		1/2 - 1 1/2	800#	SOCW	CS BODY ASTM A105,GLV201,	GLV201	
GLOBE VALVE		2 - 12	150#	FLG	CS BODY ASTM A216 GR WCB,GLV210,	GLV210	
CHECK VALVE		1/2 - 1 1/2	800#	SOCW	CS BODY ASTM A105,CHV201,	CHV201	
CHECK VALVE		2 - 24	150#	FLG	CS BODY ASTM A216 GR WCB,CHV210,	CHV210	
BALL VALVE		1/2 - 1 1/2	800#	SOCW	CS BODY ASTM A105,BAV201,	BAV201	
BALL VALVE		2 - 24	150#	FLG	CS BODY ASTM A216 GR WCB,BAV210,	BAV210	
BUTTERFLY VALVE		2 - 24	150#	RF	CS BODY ASTM A216 GR WCB,BUV203,LUG TYPE	BUV203	
BUTTERFLY VALVE		26 - 48	150#	FLG	CS BODY ASTM A216 GR WCB,BUV204,	BUV204	
PLUG VALVE		1/2 - 1	600#	THRD	CS BODY ASTM A105,PLV201,	PLV201	
PLUG VALVE		1 1/2 - 24	150#	FLG	CS BODY ASTM A216 GR WCB,PLV202,	PLV202	

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**PIPING MATERIAL SPECIFICATION**

CLIENT : M/S..TFL
 PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
 LOCATION : TALCHER,ODISHA

Project ..TFL
 DOC. No.TFL-PDS-600
 Rev.:0

Class: B40

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE CD,FG,HG,PA,PC		TEMPERATURE LIMITS (Deg.C)					
		Ref.SI	Ref.SI				
RATING ASME 150# RF	CORROSION ALLOWANCE NONE	MATERIAL SS 304L					
ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
PIPE							
PIPE		26 - 28	SCH 10	BE	EFW,STR.WELD,ASTM A312 TP304L,ASME B36.10,	PPZ511300	
PIPE		30 - 32	SCH 10	BE	EFW,STR.WELD,ASTM A312 TP304L,ASME B36.10,	PPZ511300	
PIPE		34 - 36	SCH 10	BE	EFW,STR.WELD,ASTM A312 TP304L,ASME B36.10,	PPZ511300	
PIPE		2 - 4	SCH10S	BE	EFW,STR.WELD,ASTM A312 TP304L,ASME B36.19,	PPZ511400	
PIPE		1/2 - 3/4	SCH40S	PE	SMLS,ASTM A312 TP304L,ASME B36.19,	PP8521400	
PIPE		1 - 1 1/4	SCH40S	PE	SMLS,ASTM A312 TP304L,ASME B36.19,	PP8521400	
PIPE		1 1/2 - 1 1/2	SCH40S	PE	SMLS,ASTM A312 TP304L,ASME B36.19,	PP8521400	
PIPE		6 - 8	SCH10S	BE	EFW,STR.WELD,ASTM A312 TP304L,ASME B36.19,	PPZ511400	
PIPE		10 - 12	SCH10S	BE	EFW,STR.WELD,ASTM A312 TP304L,ASME B36.19,	PPZ511400	
PIPE		14 - 16	SCH10S	BE	EFW,STR.WELD,ASTM A312 TP304L,ASME B36.19,	PPZ511400	
PIPE		18 - 20	SCH10S	BE	EFW,STR.WELD,ASTM A312 TP304L,ASME B36.19,	PPZ511400	
PIPE		22 - 24	SCH10S	BE	EFW,STR.WELD,ASTM A312 TP304L,ASME B36.19,	PPZ511400	
FLANGE							
LONG W.N.FLANGE		11/2 - 1 1/2	300#	WN-RF 125 AARH	ASTM A182 F304L,ASME B16.5,38mmBORE,200mmLONG	LN8170802	
W.N.FLANGE		26 - 36	150#	WN-RF 125 AARH	ASTM A182 F304L,ASME B16.47 SR.B,WELD NECK	WN8170701	
W.N.FLANGE		1/2 - 24	150#	WN-RF 125 AARH	ASTM A182 F304L,ASME B16.5,WELD NECK	WN8170801	5
W.N.FLANGE		1/2 - 24	300#	WN-RF 125 AARH	ASTM A182 F304L,ASME B16.5,WELD NECK	WN8170802	6
SPACER AND BLIND		14 - 24	150#	RF 125 AARH	ASTM A182 F304L,ASME B16.48,	RS812PO01	
SPECL BLIND		1/2 - 12	150#	RF 125 AARH	ASTM A182 F304L,ASME B16.48,	SP812PO01	
BLIND FLANGE							
BLIND FLANGE		26 - 36	150#	RF 125 AARH	ASTM A182 F304L,ASME B16.47 SR.B,	BF8120701	
BLIND FLANGE		1/2 - 24	150#	RF 125 AARH	ASTM A182 F304L,ASME B16.5,	BF8120801	1
BLIND FLANGE		1/2 - 24	300#	RF 125 AARH	ASTM A182 F304L,ASME B16.5,	BF8120802	2
GASKET							
GASKET		1/2 - 24	150#	SPRL-WND RF	TP304 SS WDG; GPH FLR; TP304 SS INR RNG/ OTR RNG,ASME B16.20,	GSQ130301	1
GASKET		1/2 - 24	300#	SPRL-WND RF	TP304 SS WDG; GPH FLR; TP304 SS INR RNG/ OTR RNG,ASME B16.20,	GSQ130302	2
GASKET		26 - 36	150#	SPRL-WND RF	TP304 SS WDG; GPH FLR; TP304 SS INR RNG/ OTR RNG,ASME B16.20/B16.47 SR.B,	GSQ13QJ01	
STUD & NUTS							
STUD & 2NUTS HVY		-			ASTM A193 GR.B8 CL.2/ASTM A194 GR.8,,	SNA600000	
DRIP RING							
DRIP RING		3 - 3	150#	RF 125 AARH	ASTM A182 F304L,PDIL-PDS-600,	DR812QK01	
FITTING (BW)							
BRANCH WELD		2 - 36		BW	STAINLESS STEEL,ASME B31.3,	RWOK11200	
BRANCH WELD WITH RP		2 - 36		BW	STAINLESS STEEL,ASME B31.3,	WBOK11200	
CAP		2 - 36		BW	ASTM A403 WP304L-SMLS,ASME B16.9,	CP8310900	
ELBOW		2 - 36		BW	ASTM A403 WP304L-WLDD,ASME B16.9,	EL8410900	L
ELBOW		2 - 36	19.05 MM	BW	ASTM A403 WP304L-WLDD,PDIL-PDS-600,R=3D	EL841QK60	3
ELBOW		2 - 36	19.05 MM	BW	ASTM A403 WP304L-WLDD,PDIL-PDS-600,R=5D	EL841QK60	5
REDUCER CONC.		2 - 36		BW	ASTM A403 WP304L-WLDD,ASME B16.9,	RC8410900	
REDUCER ECC.		2 - 36		BW	ASTM A403 WP304L-WLDD,ASME B16.9,	RE8410900	
TEE		2 - 36		BW	ASTM A403 WP304L-WLDD,ASME B16.9,	TE8410900	
WELDOLET		2 - 36		BW	ASTM A182 F304L,MSS SP 97,	WL8113300	
FITTING (SW)							
CAP		1/2 - 1 1/2	3000#	SOCW	ASTM A182 F304L,ASME B16.11,	CP8130207	W
COUPLING		1/2 - 1 1/2	3000#	SOCW	ASTM A182 F304L,ASME B16.11,	CN8130207	
ELBOW		1/2 - 1 1/2	3000#	SOCW	ASTM A182 F304L,ASME B16.11,	EL8130207	
HALF COUPLING		1/2 - 1 1/2	3000#	SOCW	ASTM A182 F304L,ASME B16.11,	HF8130207	
SOCKOLET		1/2 - 36	3000#	SOCW	ASTM A182 F304L,MSS SP 97,	SL8133307	

**PIPING MATERIAL SPECIFICATION**

CLIENT : M/S..TFL
 PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
 LOCATION : TALCHER,ODISHA

Project :TFL
 DOC. No.TFL-PDS-600
 Rev.:0

Class: B40

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE CD,FG,HG,PA,PC	TEMPERATURE LIMITS (Deg.C)			
	Ref.SI	Ref.SI		
RATING ASME 150# RF	CORROSION ALLOWANCE NONE	MATERIAL SS 304L		

ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
TEE		1/2 - 1 1/2	3000#	SOCW	ASTM A182 F304L,ASME B16.11,	TE8130207	
FITTING (THD)							
CAP		1/2 - 1 1/2	3000#	THD	ASTM A182 F304L,ASME B16.11,	CP8140207	T
PLUG		1/2 - 1 1/2		THD	ASTM A182 F304L,ASME B16.11,ROUND HEAD	PG8140200	
THREDOLET		1/2 - 3/6	3000#	THD	ASTM A182 F304L,MSS SP 97,	TL8143307	
NIPPLE							
NIPPLE		1/2 - 1 1/2	SCH80S	PLN-PLN	SMLS,ASTM A312 TP304L,ASME B36.19,	NP8551413	1
NIPPLE		1/2 - 1 1/2	SCH80S	PLN-THD	SMLS,ASTM A312 TP304L,ASME B36.19,NPT	NP8561413	2
NIPPLE		1/2 - 1 1/2	SCH80S	THD	SMLS,ASTM A312 TP304L,ASME B36.19,NPT	NP8541413	3
SWAGE NIPPLE							
SWAGE (CONC)		1/2 - 1 1/2		PE	ASTM A403 WP304L-SMLS,MSS SP 95,	NC83J4500	P
SWAGE (CONC)		1/2 - 1 1/2		PLN-THD	ASTM A403 WP304L-SMLS,MSS SP 95,	NC8364500	T
SWAGE (ECC)		1/2 - 1 1/2		PE	ASTM A403 WP304L-SMLS,MSS SP 95,	NE83J4500	P
SWAGE (ECC)		1/2 - 1 1/2		PLN-THD	ASTM A403 WP304L-SMLS,MSS SP 95,	NE8364500	T
VALVES							
GATE VALVE		1/2 - 1	800#	SOCW	SS BODY ASTM A182 GR F304,GAV501,	GAV501	
GATE VALVE		1 1/2 - 1 1/2	800#	SOCW	SS BODY ASTM A182 GR F304,GAV501,	GAV501	W
GATE VALVE		1 1/2 - 1 1/2	150#	FLG	SS BODY ASTM A351 GR CF8,GAV510,	GAV510	F
GATE VALVE		2 - 24	150#	FLG	SS BODY ASTM A351 GR CF8,GAV510,	GAV510	
GLOBE VALVE		1/2 - 1 1/2	800#	SOCW	SS BODY ASTM A182 GR F304,GLV501,	GLV501	
GLOBE VALVE		2 - 12	150#	FLG	SS BODY ASTM A351 GR CF8,GLV510,	GLV510	
CHECK VALVE		1/2 - 1 1/2	800#	SOCW	SS BODY ASTM A182 GR F304,CHV501,	CHV501	
CHECK VALVE		2 - 24	150#	FLG	SS BODY ASTM A351 GR CF8,CHV510,	CHV510	
BALL VALVE		1/2 - 1	800#	THRD	SS BODY AISI 316,BAV501,	BAV501	
BALL VALVE		1 1/2 - 1 1/2	800#	THRD	SS BODY AISI 316,BAV501,	BAV501	T
BALL VALVE		1 1/2 - 1 1/2	150#	FLG	SS BODY ASTM A351 GR CF8M,BAV510,	BAV510	F
BALL VALVE		2 - 12	150#	FLG	SS BODY ASTM A351 GR CF8M,BAV510,	BAV510	

**PIPING MATERIAL SPECIFICATION**

CLIENT : M/S..TFL
 PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
 LOCATION : TALCHER,ODISHA

Project ..TFL
 DOC. No.TFL-PDS-600
 Rev.:1

Class: B50

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE AF,AW,CD,DM,HZ,IA,MDA,PC,PH,VS,CH	TEMPERATURE LIMITS (Deg.C)			
	Ref.SI	Ref.SI		
RATING ASME 150# RF	CORROSION ALLOWANCE NONE	MATERIAL SS 304		

ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
PIPE							
PIPE		26 - 28	06.35 MM	BE	EFW,ASTM A358 GR.TP304 CL.1,ASME B36.10,	PPW911300	
PIPE		30 - 32	SCH 10	BE	EFW,ASTM A358 GR.TP304 CL.1,ASME B36.10,	PPW911300	
PIPE		34 - 36	SCH 10	BE	EFW,ASTM A358 GR.TP304 CL.1,ASME B36.10,	PPW911300	
PIPE		38 - 40	SCHSTD	BE	EFW,ASTM A358 GR.TP304 CL.1,ASME B36.10,	PPW911300	
PIPE		42 - 44	SCHSTD	BE	EFW,ASTM A358 GR.TP304 CL.1,ASME B36.10,	PPW911300	
PIPE		46 - 48	SCHSTD	BE	EFW,ASTM A358 GR.TP304 CL.1,ASME B36.10,	PPW911300	
PIPE		1/2 - 3/4	SCH40S	PE	SMLS,ASTM A312 TP304,ASME B36.19,	PPPE21400	
PIPE		1 - 11/4	SCH40S	PE	SMLS,ASTM A312 TP304,ASME B36.19,	PPPE21400	
PIPE		11/2 - 11/2	SCH40S	PE	SMLS,ASTM A312 TP304,ASME B36.19,	PPPE21400	
PIPE		2 - 4	SCH10S	BE	EFW,STR.WELD,ASTM A312 TP304,ASME B36.19,	PPZ111400	
PIPE		6 - 8	SCH10S	BE	EFW,STR.WELD,ASTM A312 TP304,ASME B36.19,	PPZ111400	
PIPE		10 - 12	SCH10S	BE	EFW,STR.WELD,ASTM A312 TP304,ASME B36.19,	PPZ111400	
PIPE		14 - 16	SCH10S	BE	EFW,STR.WELD,ASTM A312 TP304,ASME B36.19,	PPZ111400	
PIPE		18 - 20	SCH10S	BE	EFW,STR.WELD,ASTM A312 TP304,ASME B36.19,	PPZ111400	
PIPE		22 - 24	SCH10S	BE	EFW,STR.WELD,ASTM A312 TP304,ASME B36.19,	PPZ111400	
FLANGE							
W.N.FLANGE		26 - 48	150#	WN-RF 125 AARH	ASTM A182 F304,ASME B16.47 SR.B,WELD NECK	WN0670701	
W.N.FLANGE		1/2 - 24	150#	WN-RF 125 AARH	ASTM A182 F304,ASME B16.5,WELD NECK	WN0670801	
SPACER AND BLIND		14 - 24	150#	RF 125 AARH	ASTM A182 F304,ASME B16.48,	RS062P001	
SPECL BLIND		1/2 - 12	150#	RF 125 AARH	ASTM A182 F304,ASME B16.48,	SP062P001	
BLIND FLANGE							
BLIND FLANGE		26 - 48	150#	RF 125 AARH	ASTM A182 F304,ASME B16.47 SR.B,	BF0620701	
BLIND FLANGE		1/2 - 24	150#	RF 125 AARH	ASTM A182 F304,ASME B16.5,	BF0620801	
GASKET							
GASKET		1/2 - 24	150#	SPRL-WND RF	TP304 SS WDG; GPH FLR; TP304 SS INR RNG/ OTR RNG,ASME B16.20,	GSQ130301	
GASKET		26 - 48	150#	SPRL-WND RF	TP304 SS WDG; GPH FLR; TP304 SS INR RNG/ OTR RNG,ASME B16.20/B16.47 SR.B,	GSQ13QJ01	
STUD & NUTS							
STUD & 2NUTS HVY		-			ASTM A193 GR.B8 CL.2/ASTM A194 GR.8,,	SNA600000	
HEX							
DRIP RING							
DRIP RING		3 - 3	150#	RF 125 AARH	ASTM A182 F304,PDIL-PDS-600,	DR062QK01	
FITTING (BW)							
BRANCH WELD		2 - 48		BW	STAINLESS STEEL,ASME B31.3,	RWOK11200	
BRANCH WELD WITH RP		2 - 48		BW	STAINLESS STEEL,ASME B31.3,	WBOK11200	
CAP		2 - 48		BW	ASTM A403 WP304-SMLS,ASME B16.9,	CP7410900	
ELBOW		2 - 48		BW	ASTM A403 WP304-WLDD,ASME B16.9,	ELZ410900	
REDUCER CONC.		2 - 48		BW	ASTM A403 WP304-WLDD,ASME B16.9,	RCZ410900	
REDUCER ECC.		2 - 48		BW	ASTM A403 WP304-WLDD,ASME B16.9,	REZ410900	
TEE		2 - 48		BW	ASTM A403 WP304-WLDD,ASME B16.9,	TEZ410900	
WELDOLET		2 - 48		BW	ASTM A182 F304,MSS SP 97,	WL0613300	
FITTING (SW)							
CAP		1/2 - 11/2	3000#	SOCW	ASTM A182 F304,ASME B16.11,	CP0630207	W
COUPLING		1/2 - 11/2	3000#	SOCW	ASTM A182 F304,ASME B16.11,	CN0630207	
ELBOW		1/2 - 11/2	3000#	SOCW	ASTM A182 F304,ASME B16.11,	EL0630207	
HALF COUPLING		1/2 - 11/2	3000#	SOCW	ASTM A182 F304,ASME B16.11,	HF0630207	
SOCKOLET		1/2 - 48	3000#	SOCW	ASTM A182 F304,MSS SP 97,	SL0633307	
TEE		1/2 - 11/2	3000#	SOCW	ASTM A182 F304,ASME B16.11,	TE0630207	
FITTING (THD)							
CAP		1/2 - 11/2	3000#	THD	ASTM A182 F304,ASME B16.11,	CP0640207	T

**PIPING MATERIAL SPECIFICATION**

CLIENT : M/S..TFL
 PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
 LOCATION : TALCHER,ODISHA

Project :TFL
 DOC. No.TFL-PDS-600
 Rev.:1

Class: B50

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE AF,AW,CD,DM,HZ,IA,MDA,PC,PH,VS,CH		TEMPERATURE LIMITS (Deg.C)			
		Ref.SI	Ref.SI		
RATING ASME 150# RF	CORROSION ALLOWANCE NONE	MATERIAL SS 304			

ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
PLUG		1/2 - 11/2		THD	ASTM A182 F304,ASME B16.11,ROUND HEAD	PG0640200	
THREDOLET		1/2 - 48	3000#	THD	ASTM A182 F304,MSS SP 97,	TL0643307	
NIPPLE							
NIPPLE		1/2 - 11/2	SCH80S	PLN-PLN	SMLS,ASTM A312 TP304,ASME B36.19,	NPPE51413	1
NIPPLE		1/2 - 11/2	SCH80S	PLN-THD	SMLS,ASTM A312 TP304,ASME B36.19,NPT	NPPE61413	2
NIPPLE		1/2 - 11/2	SCH80S	THD	SMLS,ASTM A312 TP304,ASME B36.19,NPT	NPPE41413	3
SWAGE NIPPLE							
SWAGE (CONC)		1/2 - 11/2		PE	ASTM A403 WP304-SMLS,MSS SP 95,	NC74J4500	P
SWAGE (CONC)		1/2 - 11/2		PLN-THD	ASTM A403 WP304-SMLS,MSS SP 95,	NC7464500	T
SWAGE (ECC)		1/2 - 11/2		PE	ASTM A403 WP304-SMLS,MSS SP 95,	NE74J4500	P
SWAGE (ECC)		1/2 - 11/2		PLN-THD	ASTM A403 WP304-SMLS,MSS SP 95,	NE7464500	T
STRAINER							
T-TYPE STRAINER		2 - 24	150#	FLGD	SS ASTM A351 GR CF8,TTS510,	TTS510	
Y-TYPE STRAINER		2 - 24	150#	FLGD	SS ASTM A351 GR CF8,YTS510,	YTS510	
Y-TYPE STRAINER		1/2 - 11/2	600#	SOCW	ASTM A182 F304,YTS501,	YTS501	
VALVES							
GATE VALVE		1/2 - 11/2	800#	SOCW	SS BODY ASTM A182 GR F304,GAV501,	GAV501	
GATE VALVE		2 - 24	150#	FLG	SS BODY ASTM A351 GR CF8,GAV510,	GAV510	
GLOBE VALVE		1/2 - 11/2	800#	SOCW	SS BODY ASTM A182 GR F304,GLV501,	GLV501	
GLOBE VALVE		2 - 12	150#	FLG	SS BODY ASTM A351 GR CF8,GLV510,	GLV510	
CHECK VALVE		1/2 - 11/2	800#	SOCW	SS BODY ASTM A182 GR F304,CHV501,	CHV501	
CHECK VALVE		2 - 24	150#	FLG	SS BODY ASTM A351 GR CF8,CHV510,	CHV510	
CHECK VALVE		26 - 36	150#	FLG	SS BODY ASTM A351 GR CF8,CHV520,	CHV520	
BALL VALVE		1/2 - 11/2	800#	THRD	SS BODY AISI 316,BAV501,	BAV501	
BALL VALVE		2 - 6	150#	FLG	SS BODY ASTM A351 GR CF8M,BAV510,	BAV510	
BALL VALVE		8 - 24	150#	FLG	SS BODY ASTM A351 GR CF8M,BAV520,	BAV520	
BUTTERFLY VALVE		6 - 48	150#	RF	SS BODY ASTM A351 GR CF8,BUV510,WAFER TYPE	BUV510	
PLUG VALVE		1/2 - 1	600#	THRD	SS BODY AISI 316,PLV501,	PLV501	
PLUG VALVE		11/2 - 6	150#	FLG	SS BODY ASTM A351 GR CF8M,PLV510,	PLV510	

**PIPING MATERIAL SPECIFICATION**

CLIENT : M/S..TFL
 PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
 LOCATION : TALCHER,ODISHA

Project ..TFL
 DOC. No.TFL-PDS-600
 Rev.:2

Class: B52

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE		TEMPERATURE LIMITS (Deg.C)					
UL,WET ACID FLARE GAS		Ref.SI	Ref.SI				
RATING ASME	CORROSION ALLOWANCE	MATERIAL					
150# RF	NONE	SS 316L					
ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
PIPE							
PIPE		1/2 - 3/4	SCH40S	PE	SS,SMLS,ASTM A312 TP316L,ASME B36.19,	PP9121400	
PIPE		1 - 1 1/2	SCH40S	PE	SS,SMLS,ASTM A312 TP316L,ASME B36.19,	PP9121400	
PIPE		2 - 3	SCH10S	BE	SS,SMLS,ASTM A312 TP316L,ASME B36.19,	PP9111400	
PIPE		4 - 6	SCH10S	BE	SS,SMLS,ASTM A312 TP316L,ASME B36.19,	PP9111400	
PIPE		8 - 10	SCH10S	BE	SS,EFW,ASTM A358 TP316L CL.1,ASME B36.19,	PP9211400	
PIPE		12 - 14	SCH10S	BE	SS,EFW,ASTM A358 TP316L CL.1,ASME B36.19,	PP9211400	
PIPE		16 - 18	SCH10S	BE	SS,EFW,ASTM A358 TP316L CL.1,ASME B36.19,	PP9211400	
FLANGE							
FLANGE		1/2 - 1 1/2	150#	SW-RF 125 AARH	SS,ASTM A182 F316L,ASME B16.5,SOCKET WELD	FL88L0801	5
FLANGE		1/2 - 1 1/2	300#	SW-RF 125 AARH	SS,ASTM A182 F316L,ASME B16.5,SOCKET WELD	FL88L0802	6
W.N.FLANGE		2 - 4	150#	WN-RF 125 AARH	SS,ASTM A182 F316L,ASME B16.5,WELD NECK	WN8870801	5
W.N.FLANGE		6 - 18	150#	WN-RF 125 AARH	SS,ASTM A182 F316L,ASME B16.5,WELD NECK	WN8870801	
W.N.FLANGE		2 - 4	300#	WN-RF 125 AARH	SS,ASTM A182 F316L,ASME B16.5,WELD NECK	WN8870802	6
SPACER AND BLIND		18 - 18	150#	RF 125 AARH	ASTM A240 TP316L,ASME B16.48,	RS932PO01	
SPECL BLIND		1/2 - 16	150#	RF 125 AARH	ASTM A240 TP316L,ASME B16.48,	SP932PO01	
BLIND FLANGE							
BLIND FLANGE		1/2 - 18	150#	RF 125 AARH	SS,ASTM A182 F316L,ASME B16.5,	BF8820801	
GASKET							
GASKET		1/2 - 4	150#	SPRL-WND RF	GASKET,TP316L SS WDG;GPH FLR;TP316L SS INR RNG/ OTR RNG,ASME B16.20,	GS0830301	5
GASKET		6 - 18	150#	SPRL-WND RF	GASKET,TP316L SS WDG;GPH FLR;TP316L SS INR RNG/ OTR RNG,ASME B16.20,	GS0830301	
GASKET		1/2 - 4	300#	SPRL-WND RF	GASKET,TP316L SS WDG;GPH FLR;TP316L SS INR RNG/ OTR RNG,ASME B16.20,	GS0830302	6
STUD & NUTS							
STUD & 2NUTS HVY		-			ASTM A193 GR.B7/ASTM A194 GR.2H,,	SNDE00000	
HEX							
FITTING (BW)							
CAP		2 - 18		BW	SS,ASTM A403 WP316L-SMLS,ASME B16.9,	CP8910900	
ELBOW		2 - 6		BW	SS,ASTM A403 WP316L-SMLS,ASME B16.9,	EL8910900	
ELBOW		8 - 18		BW	SS,ASTM A403 WP316L-WLDD,ASME B16.9,	EL9010900	
REDUCER CONC.		2 - 6		BW	SS,ASTM A403 WP316L-SMLS,ASME B16.9,	RC8910900	
REDUCER CONC.		8 - 18		BW	SS,ASTM A403 WP316L-WLDD,ASME B16.9,	RC9010900	
REDUCER ECC.		2 - 6		BW	SS,ASTM A403 WP316L-SMLS,ASME B16.9,	RE8910900	
REDUCER ECC.		8 - 18		BW	SS,ASTM A403 WP316L-WLDD,ASME B16.9,	RE9010900	
TEE		2 - 6		BW	SS,ASTM A403 WP316L-SMLS,ASME B16.9,	TE8910900	
TEE		8 - 18		BW	SS,ASTM A403 WP316L-WLDD,ASME B16.9,	TE9010900	
WELDOLET		2 - 18		BW	SS,ASTM A182 F316L,MSS SP 97,	WL8813300	
FITTING (SW)							
CAP		1/2 - 1 1/2	3000#	SOCW	SS,ASTM A182 F316L,ASME B16.11,	CP8830207	
COUPLING		1/2 - 1 1/2	3000#	SOCW	SS,ASTM A182 F316L,ASME B16.11,	CN8830207	W
ELBOW		1/2 - 1 1/2	3000#	SOCW	SS,ASTM A182 F316L,ASME B16.11,	EL8830207	
HALF COUPLING		1/2 - 1 1/2	3000#	SOCW	SS,ASTM A182 F316L,ASME B16.11,	HF8830207	W
SOCKOLET		1/2 - 18	3000#	SOCW	SS,ASTM A182 F316L,MSS SP 97,	SL8833307	
TEE		1/2 - 1 1/2	3000#	SOCW	SS,ASTM A182 F316L,ASME B16.11,	TE8830207	
FITTING (THD)							
COUPLING		1/2 - 1 1/2	3000#	THD	SS,ASTM A182 F316L,ASME B16.11,	CN8840207	T
ELBOLET		1/2 - 18	3000#	THD	SS,ASTM A182 F316L,MSS SP 97,	ET8843307	
HALF COUPLING		1/2 - 1 1/2	3000#	THD	SS,ASTM A182 F316L,ASME B16.11,	HF8840207	T
PLUG		1/2 - 1 1/2		THD	SS,ASTM A182 F316L,ASME B16.11,ROUND HEAD	PG8840200	
THREDOLET		1/2 - 18	3000#	THD	SS,ASTM A182 F316L,MSS SP 97,	TL8843307	

**PIPING MATERIAL SPECIFICATION**

CLIENT : M/S..TFL
 PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
 LOCATION : TALCHER,ODISHA

Project :TFL
 DOC. No.TFL-PDS-600
 Rev.:2

Class: B52

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE UL.WET ACID FLARE GAS	TEMPERATURE LIMITS (Deg.C)			
	Ref.SI	Ref.SI		
RATING ASME 150# RF	CORROSION ALLOWANCE NONE	MATERIAL SS 316L		

ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
NIPPLE							
NIPPLE		1/2 - 11/2	SCH80S	PLN-PLN	SS,SMLS,ASTM A312 TP316L,ASME B36.19,	NP9151413	1
NIPPLE		1/2 - 11/2	SCH80S	PLN-THD	SS,SMLS,ASTM A312 TP316L,ASME B36.19,	NP9161413	2
NIPPLE		1/2 - 11/2	SCH80S	THD	SS,SMLS,ASTM A312 TP316L,ASME B36.19,	NP9141413	3
SWAGE NIPPLE							
SWAGE (CONC)		1/2 - 11/2		PE	SS,ASTM A182 F316L,MSS SP 95,	NC88J4500	
SWAGE (ECC)		1/2 - 11/2		PE	SS,ASTM A182 F316L,MSS SP 95,	NE88J4500	
VALVES							
GATE VALVE		1/2 - 11/2	800#	SOCW	SS BODY AISI 316L,GAV401,	GAV401	
GATE VALVE		2 - 6	150#	FLG	SS BODY ASTM A351 GR CF3M,GAV410,	GAV410	
GLOBE VALVE		1/2 - 11/2	800#	SOCW	SS BODY AISI 316L,GLV401,	GLV401	
GLOBE VALVE		2 - 6	150#	FLG	SS BODY ASTM A351 GR CF3M,GLV410,	GLV410	
CHECK VALVE		1/2 - 11/2	800#	SOCW	SS BODY AISI 316L,CHV401,	CHV401	
CHECK VALVE		2 - 12	150#	FLG	SS BODY ASTM A351 GR CF3M,CHV410,	CHV410	
BUTTERFLY VALVE		6 - 18	150#	RF	SS BODY ASTM A351 GR CF3M,BUV410,WAFER TYPE	BUV410	

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**PIPING MATERIAL SPECIFICATION**

CLIENT : M/S..TFL
 PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
 LOCATION : TALCHER,ODISHA

Project ..TFL
 DOC. No.TFL-PDS-600
 Rev.:1

Class: D14

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE AG,AL,FG	TEMPERATURE LIMITS (Deg.C)			
	Ref.SI	Ref.SI		
RATING ASME 300# RF	CORROSION ALLOWANCE 1.5 MM(MIN.)	MATERIAL LT CS		

ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
PIPE							
PIPE		2 - 6	SCH 40	BE	SMLS,ASTM A333 GR.6,ASME B36.10,	PPP611300	
PIPE		8 - 10	SCH 30	BE	SMLS,ASTM A333 GR.6,ASME B36.10,	PPP611300	
PIPE		12 - 14	SCH 40	BE	SMLS,ASTM A333 GR.6,ASME B36.10,	PPP611300	
PIPE		1/2 - 3/4	SCH 80	PE	SMLS,ASTM A333 GR.6,ASME B36.10,	PPP621300	
PIPE		1 - 1 1/4	SCH 80	PE	SMLS,ASTM A333 GR.6,ASME B36.10,	PPP621300	
PIPE		1 1/2 - 1 1/2	SCH 80	PE	SMLS,ASTM A333 GR.6,ASME B36.10,	PPP621300	
PIPE		16 - 18	SCH 40	BE	SMLS,ASTM A333 GR.6,ASME B36.10,	PPP611300	
PIPE		20 - 22	SCH 40	BE	SMLS,ASTM A333 GR.6,ASME B36.10,	PPP611300	
PIPE		24 - 24	SCH 40	BE	SMLS,ASTM A333 GR.6,ASME B36.10,	PPP611300	
FLANGE							
LONG W.N.FLANGE		1 1/2 - 1 1/2	300#	WN-RF 125 AARH	ASTM A350 LF2 CL.1,ASME B16.5,38mmBORE,200mmLONG	LN3570802	
W.N.FLANGE		1/2 - 24	300#	WN-RF 125 AARH	ASTM A350 LF2 CL.1,ASME B16.5,WELD NECK	WN3570802	
SPACER AND BLIND		14 - 24	300#	RF 125 AARH	ASTM A350 LF2 CL.1,ASME B16.48,	RS352PO02	
SPECL BLIND		1/2 - 12	300#	RF 125 AARH	ASTM A350 LF2 CL.1,ASME B16.48,	SP352PO02	
BLIND FLANGE							
BLIND FLANGE		1/2 - 24	300#	RF 125 AARH	ASTM A350 LF2 CL.1,ASME B16.5,	BF3520802	
GASKET							
GASKET		1/2 - 24	300#	SPRL-WND RF	TP304 SS WDG;GPH FLR;TP304 SS INR RNG;CS OTR RNG,ASME B16.20,	GSQN30302	
STUD & NUTS							
STUD & 2NUTS HVY		-			ASTM A320 GR.L7/ASTM A194 GR.7,,	SNDA00000	
HEX							
FITTING (BW)							
BRANCH WELD WITH		2 - 24		BW	LT CARBON STEEL,ASME B31.3,	WBE211200	
RP							
CAP		2 - 24		BW	ASTM A420 WPL6-SMLS,ASME B16.9,	CP4910900	
ELBOW		2 - 24		BW	ASTM A420 WPL6-SMLS,ASME B16.9,	EL4910900	
REDUCER CONC.		2 - 24		BW	ASTM A420 WPL6-SMLS,ASME B16.9,	RC4910900	
REDUCER ECC.		2 - 24		BW	ASTM A420 WPL6-SMLS,ASME B16.9,	RE4910900	
TEE		2 - 24		BW	ASTM A420 WPL6-SMLS,ASME B16.9,	TE4910900	
WELDOLET		2 - 24		BW	ASTM A350 LF2 CL.1,MSS SP 97,	WL3513300	
FITTING (SW)							
CAP		1/2 - 1 1/2	3000#	SOCW	ASTM A350 LF2 CL.1,ASME B16.11,	CP3530207	W
COUPLING		1/2 - 1 1/2	3000#	SOCW	ASTM A350 LF2 CL.1,ASME B16.11,	CN3530207	
ELBOW		1/2 - 1 1/2	3000#	SOCW	ASTM A350 LF2 CL.1,ASME B16.11,	EL3530207	
HALF COUPLING		1/2 - 1 1/2	3000#	SOCW	ASTM A350 LF2 CL.1,ASME B16.11,	HF3530207	
SOCKOLET		1/2 - 24	3000#	SOCW	ASTM A350 LF2 CL.1,MSS SP 97,	SL3533307	
TEE		1/2 - 1 1/2	3000#	SOCW	ASTM A350 LF2 CL.1,ASME B16.11,	TE3530207	
FITTING (THD)							
CAP		1/2 - 1 1/2	3000#	THD	ASTM A350 LF2 CL.1,ASME B16.11,	CP3540207	T
PLUG		1/2 - 1 1/2		THD	ASTM A350 LF2 CL.1,ASME B16.11,ROUND HEAD	PG3540200	
THREDOLET		1/2 - 24	3000#	THD	ASTM A350 LF2 CL.1,MSS SP 97,	TL3543307	
NIPPLE							
NIPPLE		1/2 - 1 1/2	SCH160	PLN-PLN	SMLS,ASTM A333 GR.6,ASME B36.10,	NPP651312	1
NIPPLE		1/2 - 1 1/2	SCH160	PLN-THD	SMLS,ASTM A333 GR.6,ASME B36.10,NPT	NPP661312	2
NIPPLE		1/2 - 1 1/2	SCH160	THD	SMLS,ASTM A333 GR.6,ASME B36.10,NPT	NPP641312	3
SWAGE NIPPLE							
SWAGE (CONC)		1/2 - 1 1/2		PE	ASTM A420 WPL6-SMLS,MSS SP 95,	NC49J4500	P
SWAGE (CONC)		1/2 - 1 1/2		PLN-THD	ASTM A420 WPL6-SMLS,MSS SP 95,	NC4964500	T
SWAGE (ECC)		1/2 - 1 1/2		PE	ASTM A420 WPL6-SMLS,MSS SP 95,	NE49J4500	P
SWAGE (ECC)		1/2 - 1 1/2		PLN-THD	ASTM A420 WPL6-SMLS,MSS SP 95,	NE4964500	T
VALVES							



PIPING MATERIAL SPECIFICATION

CLIENT : M/S..TFL
PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
LOCATION : TALCHER,ODISHA

Project :TFL
DOC. No.TFL-PDS-600
Rev.:1

Class: D14

PROJECTS AND DEVELOPMENT INDIA LIMITED

Table with columns: SERVICE AG,AL,FG; TEMPERATURE LIMITS (Deg.C) with sub-columns Ref.SI; MATERIAL LT CS

Table with columns: RATING ASME 300# RF; CORROSION ALLOWANCE 1.5 MM(MIN.); MATERIAL LT CS

Main table with columns: ITEM, NOTES, SIZE (NPS), SCH/ RAT, END, DESCRIPTION, COMM CODE, SPCL REV. Contains 13 rows of valve specifications.

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**PIPING MATERIAL SPECIFICATION**

CLIENT : M/S..TFL
 PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
 LOCATION : TALCHER,ODISHA

Project :TFL
 DOC. No.TFL-PDS-600
 Rev.:0

Class: D24

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE AG,AL,AW,FG,FN,HG,IAH,IAW,NG,NI,PA,PN,VS ETC.		TEMPERATURE LIMITS (Deg.C)					
		Ref SI	Ref SI				
RATING ASME 300# RF	CORROSION ALLOWANCE 1.5 MM(MIN)	MATERIAL CS					
ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
PIPE							
PIPE		2 - 6	SCH 40	BE	SMLS,API 5L GR.B,ASME B36.10,	PPA111300	
PIPE		8 - 8	SCH 20	BE	SMLS,API 5L GR.B,ASME B36.10,	PPA111300	
PIPE		1/2 - 3/4	SCH 80	PE	SMLS,API 5L GR.B,ASME B36.10,	PPA121300	
PIPE		1 - 11/4	SCH 80	PE	SMLS,API 5L GR.B,ASME B36.10,	PPA121300	
PIPE		11/2 - 11/2	SCH 80	PE	SMLS,API 5L GR.B,ASME B36.10,	PPA121300	
PIPE		10 - 12	SCH 30	BE	SMLS,API 5L GR.B,ASME B36.10,	PPA111300	
PIPE		14 - 14	SCH 30	BE	SMLS,API 5L GR.B,ASME B36.10,	PPA111300	
PIPE		16 - 18	SCH XS	BE	SMLS,API 5L GR.B,ASME B36.10,	PPA111300	
PIPE		20 - 20	SCH XS	BE	SMLS,API 5L GR.B,ASME B36.10,	PPA111300	
PIPE		22 - 22	17.48 MM	BE	SMLS,API 5L GR.B,ASME B36.10,	PPA111300	
PIPE		24 - 24	SCH 40	BE	SMLS,API 5L GR.B,ASME B36.10,	PPA111300	
PIPE		26 - 28	17.40 MM	BE	SMLS,API 5L GR.B,ASME B36.10,	PPA111300	
FLANGE							
LONG W.N.FLANGE		11/2 - 11/2	300#	WN-RF 125 AARH	CS ASTM A105,ASME B16.5,38mmBORE,200mmLONG	LN0270802	
W.N.FLANGE		26 - 28	300#	WN-RF 125 AARH	CS ASTM A105,ASME B16.47 SR.B,WELD NECK	WN0270702	
W.N.FLANGE		1/2 - 24	300#	WN-RF 125 AARH	CS ASTM A105,ASME B16.5,WELD NECK	WN0270802	
SPACER AND BLIND		14 - 24	300#	RF 125 AARH	CS ASTM A105,ASME B16.48,	RS022P002	
SPECL BLIND		1/2 - 12	300#	RF 125 AARH	CS ASTM A105,ASME B16.48,	SP022P002	
BLIND FLANGE							
BLIND FLANGE		26 - 28	300#	RF 125 AARH	CS ASTM A105,ASME B16.47 SR.B,	BF0220702	
BLIND FLANGE		1/2 - 24	300#	RF 125 AARH	CS ASTM A105,ASME B16.5,	BF0220802	
GASKET							
GASKET		1/2 - 24	300#	SPRL-WND RF	TP304 SS WDG;GPH FLR;TP304 SS INR RNG;CS OTR RNG,ASME B16.20,	GSQN30302	
GASKET		26 - 28	300#	SPRL-WND RF	TP304 SS WDG;GPH FLR;TP304 SS INR RNG;CS OTR RNG,ASME B16.20/B16.47 SR.B,	GSQN3QJ02	
STUD & NUTS							
STUD & 2NUTS HVY HEX		-			ASTM A193 GR.B7/ASTM A194 GR.2H,,	SNDE00000	
DRIP RING							
DRIP RING		3 - 3	300#	RF 125 AARH	CS ASTM A105,PDIL-PDS-600,	DR022QK02	
FITTING (BW)							
BRANCH WELD		2 - 28		BW	CARBON STEEL,ASME B31.3,	RWOJ11200	
BRANCH WELD WITH RP		2 - 28		BW	CARBON STEEL,ASME B31.3,	WBOJ11200	
CAP		2 - 28		BW	ASTM A234 WPB-SMLS,ASME B16.9,	CP7310900	
ELBOW		2 - 28		BW	ASTM A234 WPB-SMLS,ASME B16.9,	EL7310900	
REDUCER CONC.		2 - 28		BW	ASTM A234 WPB-SMLS,ASME B16.9,	RC7310900	
REDUCER ECC.		2 - 28		BW	ASTM A234 WPB-SMLS,ASME B16.9,	RE7310900	
TEE		2 - 28		BW	ASTM A234 WPB-SMLS,ASME B16.9,	TE7310900	
WELDOLET		2 - 28		BW	CS ASTM A105,MSS SP 97,	WL0213300	
FITTING (SW)							
CAP		1/2 - 11/2	3000#	SOCW	CS ASTM A105,ASME B16.11,	CP0230207	W
COUPLING		1/2 - 11/2	3000#	SOCW	CS ASTM A105,ASME B16.11,	CN0230207	
ELBOW		1/2 - 11/2	3000#	SOCW	CS ASTM A105,ASME B16.11,	EL0230207	
HALF COUPLING		1/2 - 11/2	3000#	SOCW	CS ASTM A105,ASME B16.11,	HF0230207	
SOCKOLET		1/2 - 28	3000#	SOCW	CS ASTM A105,MSS SP 97,	SL0233307	
TEE		1/2 - 11/2	3000#	SOCW	CS ASTM A105,ASME B16.11,	TE0230207	
FITTING (THD)							
CAP		1/2 - 11/2	3000#	THD	CS ASTM A105,ASME B16.11,	CP0240207	T
PLUG		1/2 - 11/2		THD	CS ASTM A105,ASME B16.11,ROUND HEAD	PG0240200	
THREDOLET		1/2 - 28	3000#	THD	CS ASTM A105,MSS SP 97,	TL0243307	



PIPING MATERIAL SPECIFICATION

CLIENT : M/S..TFL
 PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
 LOCATION : TALCHER,ODISHA

Project :TFL
 DOC. No.TFL-PDS-600
 Rev.:0

Class: D24

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE AG,AL,AW,FG,FN,HG,IAH,IAW,NG,NI,PA,PN,VS ETC.	TEMPERATURE LIMITS (Deg.C)			
	Ref SI	Ref SI		
RATING ASME 300# RF	CORROSION ALLOWANCE 1.5 MM(MIN)	MATERIAL CS		

ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
NIPPLE							
NIPPLE		1/2 - 1 1/2	SCH160	PLN-PLN	SMLS,API 5L GR.B,ASME B36.10,	NPA151312	1
NIPPLE		1/2 - 1 1/2	SCH160	PLN-THD	SMLS,API 5L GR.B,ASME B36.10,NPT	NPA161312	2
NIPPLE		1/2 - 1 1/2	SCH160	THD	SMLS,API 5L GR.B,ASME B36.10,NPT	NPA141312	3
SWAGE NIPPLE							
SWAGE (CONC)		1/2 - 1 1/2		PE	ASTM A234 WPB-SMLS,MSS SP 95,	NC73J4500	P
SWAGE (CONC)		1/2 - 1 1/2		PLN-THD	ASTM A234 WPB-SMLS,MSS SP 95,	NC7364500	T
SWAGE (ECC)		1/2 - 1 1/2		PE	ASTM A234 WPB-SMLS,MSS SP 95,	NE73J4500	P
SWAGE (ECC)		1/2 - 1 1/2		PLN-THD	ASTM A234 WPB-SMLS,MSS SP 95,	NE7364500	T
VALVES							
GATE VALVE		2 - 24	300#	FLG	CS BODY ASTM A216 GR WCB,GAV211,	GAV211	
GATE VALVE		1/2 - 1 1/2	800#	SOCW	CS BODY ASTM A105,GAV201,	GAV201	
GLOBE VALVE		1/2 - 1 1/2	800#	SOCW	CS BODY ASTM A105,GLV201,	GLV201	
GLOBE VALVE		2 - 12	300#	FLG	CS BODY ASTM A216 GR WCB,GLV211,	GLV211	
CHECK VALVE		1/2 - 1 1/2	800#	SOCW	CS BODY ASTM A105,CHV201,	CHV201	
CHECK VALVE		2 - 24	300#	FLG	CS BODY ASTM A216 GR WCB,CHV211,	CHV211	
BALL VALVE		1/2 - 1 1/2	800#	SOCW	CS BODY ASTM A105,BAV202,	BAV202	
BALL VALVE		2 - 6	300#	FLG	CS BODY ASTM A216 GR WCB,BAV211,	BAV211	
BALL VALVE		8 - 24	300#	FLG	CS BODY ASTM A216 GR WCB,BAV221,	BAV221	
BUTTERFLY VALVE		3 - 24	300#	RF	CS BODY ASTM A216 GR WCB,BUV202,WAFER TYPE	BUV202	
PLUG VALVE		1/2 - 1	600#	THRD	CS BODY ASTM A105,PLV201,	PLV201	
PLUG VALVE		1 1/2 - 6	300#	FLG	CS BODY ASTM A216 GR WCB,PLV205,	PLV205	

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**PIPING MATERIAL SPECIFICATION**

CLIENT : M/S..TFL
 PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
 LOCATION : TALCHER,ODISHA

Project ..TFL
 DOC. No.TFL-PDS-600
 Rev.:0

Class: D50

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE AW,PH,PC,AF,DM,MD,IA	TEMPERATURE LIMITS (Deg.C)			
	Ref SI	Ref SI		
RATING ASME 300# RF	CORROSION ALLOWANCE NONE	MATERIAL SS 304		

ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
PIPE							
PIPE		14 - 14	SCHSTD	BE	EFW,STR.WELD,ASTM A312 TP304,ASME B36.10,	PPZ111300	
PIPE		16 - 18	SCH XS	BE	EFW,ASTM A358 GR.TP304 CL.1,ASME B36.10,	PPW911300	
PIPE		20 - 20	SCH XS	BE	EFW,ASTM A358 GR.TP304 CL.1,ASME B36.10,	PPW911300	
PIPE		24 - 24	SCH 40	BE	EFW,ASTM A358 GR.TP304 CL.1,ASME B36.10,	PPW911300	
PIPE		26 - 28	17.48 MM	BE	EFW,ASTM A358 GR.TP304 CL.1,ASME B36.10,	PPW911300	
PIPE		1/2 - 3/4	SCH40S	PE	SMLS,ASTM A312 TP304,ASME B36.19,	PPPE21400	
PIPE		1 - 1 1/4	SCH40S	PE	SMLS,ASTM A312 TP304,ASME B36.19,	PPPE21400	
PIPE		1 1/2 - 1 1/2	SCH40S	PE	SMLS,ASTM A312 TP304,ASME B36.19,	PPPE21400	
PIPE		2 - 4	SCH10S	BE	EFW,STR.WELD,ASTM A312 TP304,ASME B36.19,	PPZ111400	
PIPE		6 - 8	SCH40S	BE	EFW,STR.WELD,ASTM A312 TP304,ASME B36.19,	PPZ111400	
PIPE		10 - 12	SCH40S	BE	EFW,STR.WELD,ASTM A312 TP304,ASME B36.19,	PPZ111400	
FLANGE							
W.N.FLANGE		26 - 28	300#	WN-RF 125 AARH	ASTM A182 F304,ASME B16.47 SR.B,WELD NECK	WN0670702	
W.N.FLANGE		1/2 - 24	300#	WN-RF 125 AARH	ASTM A182 F304,ASME B16.5,WELD NECK	WN0670802	
SPACER AND BLIND		14 - 28	300#	RF 125 AARH	ASTM A182 F304,ASME B16.48,	RS062P002	
SPECL BLIND		1/2 - 12	300#	RF 125 AARH	ASTM A182 F304,ASME B16.48,	SP062P002	
BLIND FLANGE							
BLIND FLANGE		26 - 28	300#	RF 125 AARH	ASTM A182 F304,ASME B16.47 SR.B,	BF0620702	
BLIND FLANGE		1/2 - 28	300#	RF 125 AARH	ASTM A182 F304,ASME B16.5,	BF0620802	
GASKET							
GASKET		1/2 - 24	300#	SPRL-WND RF	TP304 SS WDG/ GPH FLR; TP304 SS INR RNG/ OTR RNG,ASME B16.20,	GSQL30302	
GASKET		26 - 28	300#	SPRL-WND RF	TP304 SS WDG/ GPH FLR; TP304 SS INR RNG/ OTR RNG,ASME B16.20/B16.47 SR.B,	GSQL3QJ02	
STUD & NUTS							
STUD & 2NUTS HVY		-			ASTM A193 GR.B8T CL.2/ASTM A194 GR.8TA,,	SNQG00000	
HEX							
DRIP RING							
DRIP RING		3 - 12	300#	RF 125 AARH	ASTM A182 F304,PDIL-PDS-600,	DR062QK02	
FITTING (BW)							
BRANCH WELD		2 - 28		BW	STAINLESS STEEL,ASME B31.3,	RWOK11200	
BRANCH WELD WITH RP		2 - 28		BW	STAINLESS STEEL,ASME B31.3,	WBOK11200	
CAP		2 - 24		BW	ASTM A403 WP304-SMLS,ASME B16.9,	CP7410900	
ELBOW		2 - 28		BW	ASTM A403 WP304-WLDD,ASME B16.9,	ELZ410900	L
ELBOW		2 - 28	19.05 MM	BW	ASTM A403 WP304-WLDD,PDIL-PDS-600,R=3D	ELZ41QK60	3
REDUCER CONC.		2 - 28		BW	ASTM A403 WP304-WLDD,ASME B16.9,	RCZ410900	
REDUCER ECC.		2 - 28		BW	ASTM A403 WP304-WLDD,ASME B16.9,	REZ410900	
TEE		2 - 28		BW	ASTM A403 WP304-WLDD,ASME B16.9,	TEZ410900	
WELDOLET		2 - 28		BW	ASTM A182 F304,MSS SP 97,	WL0613300	
FITTING (SW)							
CAP		1/2 - 1 1/2	3000#	SOCW	ASTM A182 F304,ASME B16.11,	CP0630207	W
COUPLING		1/2 - 1 1/2	3000#	SOCW	ASTM A182 F304,ASME B16.11,	CN0630207	
ELBOW		1/2 - 1 1/2	3000#	SOCW	ASTM A182 F304,ASME B16.11,	EL0630207	
HALF COUPLING		1/2 - 1 1/2	3000#	SOCW	ASTM A182 F304,ASME B16.11,	HF0630207	
SOCKOLET		1/2 - 28	3000#	SOCW	ASTM A182 F304,MSS SP 97,	SL0633307	
TEE		1/2 - 1 1/2	3000#	SOCW	ASTM A182 F304,ASME B16.11,	TE0630207	
FITTING (THD)							
CAP		1/2 - 1 1/2	3000#	THD	ASTM A182 F304,ASME B16.11,	CP0640207	T
PLUG		1/2 - 1 1/2		THD	ASTM A182 F304,ASME B16.11,ROUND HEAD	PG0640200	
THREDOLET		1/2 - 28	3000#	THD	ASTM A182 F304,MSS SP 97,	TL0643307	
NIPPLE							



PIPING MATERIAL SPECIFICATION

CLIENT : M/S..TFL
 PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
 LOCATION : TALCHER,ODISHA

Project :TFL
 DOC. No.TFL-PDS-600
 Rev.:0

Class: D50

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE AW,PH,PC,AF,DM,MD,IA	TEMPERATURE LIMITS (Deg.C)			
	Ref SI	Ref SI		
RATING ASME 300# RF	CORROSION ALLOWANCE NONE	MATERIAL SS 304		

ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
NIPPLE		1/2 - 1 1/2	SCH80S	PLN-PLN	SMLS,ASTM A312 TP304,ASME B36.19,	NPPE51413	1
NIPPLE		1/2 - 1 1/2	SCH80S	PLN-THD	SMLS,ASTM A312 TP304,ASME B36.19,NPT	NPPE61413	2
NIPPLE		1/2 - 1 1/2	SCH80S	THD	SMLS,ASTM A312 TP304,ASME B36.19,NPT	NPPE41413	3
SWAGE NIPPLE							
SWAGE (CONC)		1/2 - 1 1/2		PE	ASTM A403 WP304-SMLS,MSS SP 95,	NC74J4500	P
SWAGE (CONC)		1/2 - 1 1/2		PLN-THD	ASTM A403 WP304-SMLS,MSS SP 95,	NC7464500	T
SWAGE (ECC)		1/2 - 1 1/2		PE	ASTM A403 WP304-SMLS,MSS SP 95,	NE74J4500	P
SWAGE (ECC)		1/2 - 1 1/2		PLN-THD	ASTM A403 WP304-SMLS,MSS SP 95,	NE7464500	T
VALVES							
GATE VALVE		1/2 - 1	800#	SOCW	SS BODY ASTM A182 GR F304,GAV501,	GAV501	
GATE VALVE		1 1/2 - 1 1/2	800#	SOCW	SS BODY ASTM A182 GR F304,GAV501,	GAV501	W
GATE VALVE		1 1/2 - 1 1/2	300#	FLG	SS BODY ASTM A351 GR CF8M,GAV511,	GAV511	F
GATE VALVE		2 - 24	300#	FLG	SS BODY ASTM A351 GR CF8M,GAV511,	GAV511	
GLOBE VALVE		1/2 - 1 1/2	800#	SOCW	SS BODY ASTM A182 GR F304,GLV501,	GLV501	
GLOBE VALVE		2 - 12	300#	FLG	SS BODY ASTM A351 GR CF8M,GLV511,	GLV511	
CHECK VALVE		1/2 - 1 1/2	800#	SOCW	SS BODY ASTM A182 GR F304,CHV501,	CHV501	
CHECK VALVE		2 - 24	300#	FLG	SS BODY ASTM A351 GR CF8M,CHV511,	CHV511	
BALL VALVE		1/2 - 1 1/2	800#	THRD	SS BODY AISI 316,BAV501,	BAV501	
BALL VALVE		8 - 24	300#	FLG	SS BODY ASTM A351 GR CF8M,BAV521,	BAV521	
PLUG VALVE		1/2 - 1	600#	THRD	SS BODY AISI 316,PLV501,	PLV501	
PLUG VALVE		1 1/2 - 6	300#	FLG	SS BODY ASTM A351 GR CF8M,PLV511,	PLV511	

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**PIPING MATERIAL SPECIFICATION**

CLIENT : M/S..TFL
 PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
 LOCATION : TALCHER,ODISHA

Project :TFL
 DOC. No.TFL-PDS-600
 Rev.:2

Class: D52

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE UL	TEMPERATURE LIMITS (Deg.C)						
	Ref.SI	Ref.SI					
RATING ASME 300# RF	CORROSION ALLOWANCE NONE	MATERIAL SS 316L					
ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
PIPE							
PIPE		1/2 - 3/4	SCH40S	PE	SS,SMLS,ASTM A312 TP316L,ASME B36.19,	PP9121400	
PIPE		1 - 1 1/2	SCH40S	PE	SS,SMLS,ASTM A312 TP316L,ASME B36.19,	PP9121400	
PIPE		2 - 3	SCH10S	BE	SS,SMLS,ASTM A312 TP316L,ASME B36.19,	PP9111400	
PIPE		4 - 6	SCH10S	BE	SS,SMLS,ASTM A312 TP316L,ASME B36.19,	PP9111400	
PIPE		8 - 10	SCH10S	BE	SS,EFW,ASTM A358 TP316L CL.1,ASME B36.19,	PP9211400	
PIPE		12 - 14	SCH10S	BE	SS,EFW,ASTM A358 TP316L CL.1,ASME B36.19,	PP9211400	
PIPE		16 - 18	SCH10S	BE	SS,EFW,ASTM A358 TP316L CL.1,ASME B36.19,	PP9211400	
FLANGE							
FLANGE		1/2 - 1 1/2	300#	SW-RF 125 AARH	SS,ASTM A182 F316L,ASME B16.5,SOCKET WELD	FL88L0802	
W.N.FLANGE		2 - 18	300#	WN-RF 125 AARH	SS,ASTM A182 F316L,ASME B16.5,WELD NECK	WN8870802	
SPACER AND BLIND		18 - 18	300#	RF 125 AARH	ASTM A240 TP316L,ASME B16.48,	RS932PO02	
SPECL BLIND		1/2 - 16	300#	RF 125 AARH	ASTM A240 TP316L,ASME B16.48,	SP932PO02	
BLIND FLANGE							
BLIND FLANGE		1/2 - 18	300#	RF 125 AARH	SS,ASTM A182 F316L,ASME B16.5,	BF8820802	
GASKET							
GASKET		1/2 - 18	300#	SPRL-WND RF	GASKET,TP316L SS WDG;GPH FLR;TP316L SS INR RNG/ OTR RNG,ASME B16.20,	GS0830302	
STUD & NUTS							
STUD & 2NUTS HVY		-			ASTM A193 GR.B7/ASTM A194 GR.2H,,	SNDE00000	
HEX							
FITTING (BW)							
CAP		2 - 18		BW	SS,ASTM A403 WP316L-SMLS,ASME B16.9,	CP8910900	
ELBOW		2 - 6		BW	SS,ASTM A403 WP316L-SMLS,ASME B16.9,	EL8910900	
ELBOW		8 - 18		BW	SS,ASTM A403 WP316L-WLDD,ASME B16.9,	EL9010900	
REDUCER CONC.		2 - 6		BW	SS,ASTM A403 WP316L-SMLS,ASME B16.9,	RC8910900	
REDUCER CONC.		8 - 18		BW	SS,ASTM A403 WP316L-WLDD,ASME B16.9,	RC9010900	
REDUCER ECC.		2 - 6		BW	SS,ASTM A403 WP316L-SMLS,ASME B16.9,	RE8910900	
REDUCER ECC.		8 - 18		BW	SS,ASTM A403 WP316L-WLDD,ASME B16.9,	RE9010900	
TEE		2 - 6		BW	SS,ASTM A403 WP316L-SMLS,ASME B16.9,	TE8910900	
TEE		8 - 18		BW	SS,ASTM A403 WP316L-WLDD,ASME B16.9,	TE9010900	
WELDOLET		2 - 18		BW	SS,ASTM A182 F316L,MSS SP 97,	WL8813300	
FITTING (SW)							
CAP		1/2 - 1 1/2	3000#	SOCW	SS,ASTM A182 F316L,ASME B16.11,	CP8830207	
COUPLING		1/2 - 1 1/2	3000#	SOCW	SS,ASTM A182 F316L,ASME B16.11,	CN8830207	W
ELBOW		1/2 - 1 1/2	3000#	SOCW	SS,ASTM A182 F316L,ASME B16.11,	EL8830207	
HALF COUPLING		1/2 - 1 1/2	3000#	SOCW	SS,ASTM A182 F316L,ASME B16.11,	HF8830207	W
SOCKOLET		1/2 - 18	3000#	SOCW	SS,ASTM A182 F316L,MSS SP 97,	SL8833307	
TEE		1/2 - 2 1/2	3000#	SOCW	SS,ASTM A182 F316L,ASME B16.11,	TE8830207	
FITTING (THD)							
COUPLING		1/2 - 1 1/2	3000#	THD	SS,ASTM A182 F316L,ASME B16.11,	CN8840207	T
ELBOLET		1/2 - 18	3000#	THD	SS,ASTM A182 F316L,MSS SP 97,	ET8843307	
HALF COUPLING		1/2 - 1 1/2	3000#	THD	SS,ASTM A182 F316L,ASME B16.11,	HF8840207	T
PLUG		1/2 - 1 1/2		THD	SS,ASTM A182 F316L,ASME B16.11,ROUND HEAD	PG8840200	
THREDOLET		1/2 - 18	3000#	THD	SS,ASTM A182 F316L,MSS SP 97,	TL8843307	
NIPPLE							
NIPPLE		1/2 - 1 1/2	SCH80S	PLN-PLN	SS,SMLS,ASTM A312 TP316L,ASME B36.19,	NP9151413	1
NIPPLE		1/2 - 1 1/2	SCH80S	PLN-THD	SS,SMLS,ASTM A312 TP316L,ASME B36.19,	NP9161413	2
NIPPLE		1/2 - 1 1/2	SCH80S	THD	SS,SMLS,ASTM A312 TP316L,ASME B36.19,	NP9141413	3
SWAGE NIPPLE							
SWAGE (CONC)		1/2 - 1 1/2		PE	SS,ASTM A182 F316L,MSS SP 95,	NC88J4500	
SWAGE (ECC)		1/2 - 1 1/2		PE	SS,ASTM A182 F316L,MSS SP 95,	NE88J4500	

**PIPING MATERIAL SPECIFICATION**

CLIENT : M/S..TFL
 PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
 LOCATION : TALCHER,ODISHA

Project :TFL
 DOC. No.TFL-PDS-600
 Rev.:2

Class: D52

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE UL	TEMPERATURE LIMITS (Deg.C)			
	Ref.SI	Ref.SI		
RATING ASME 300# RF	CORROSION ALLOWANCE NONE	MATERIAL SS 316L		

ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
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VALVES

GATE VALVE		1/2 - 11/2	800#	SOCW	SS BODY AISI 316L,GAV401,	GAV401	
GATE VALVE		2 - 6	300#	FLG	SS BODY ASTM A351 GR CF3M,GAV411,	GAV411	
GLOBE VALVE		1/2 - 11/2	800#	SOCW	SS BODY AISI 316L,GLV401,	GLV401	
GLOBE VALVE		2 - 6	300#	FLG	SS BODY ASTM A351 GR CF3M,GLV411,	GLV411	
CHECK VALVE		1/2 - 11/2	800#	SOCW	SS BODY AISI 316L,CHV401,	CHV401	
CHECK VALVE		2 - 12	300#	FLG	SS BODY ASTM A351 GR CF3M,CHV411,	CHV411	
BUTTERFLY VALVE		6 - 18	300#	RF	SS BODY ASTM A351 GR CF3M,BUV411,WAFFER TYPE	BUV411	

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**PIPING MATERIAL SPECIFICATION**

CLIENT : M/S..TFL
 PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
 LOCATION : TALCHER,ODISHA

Project :TFL
 DOC. No.TFL-PDS-600
 Rev.:0

Class: F24

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE AW,HG,PA,PC,PN,SG		TEMPERATURE LIMITS (Deg.C)					
		Ref SI	Ref SI				
RATING ASME 600# RF	CORROSION ALLOWANCE 1.5 MM(MIN.)	MATERIAL CS					
ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
PIPE							
PIPE		2 - 3	SCH 40	BE	SMLS,API 5L GR.B,ASME B36.10,	PPA111300	
PIPE		4 - 5	SCH 80	BE	SMLS,API 5L GR.B,ASME B36.10,	PPA111300	
PIPE		6 - 8	SCH 80	BE	SMLS,API 5L GR.B,ASME B36.10,	PPA111300	
PIPE		10 - 12	SCH 80	BE	SMLS,API 5L GR.B,ASME B36.10,	PPA111300	
PIPE		14 - 16	SCH 80	BE	SMLS,API 5L GR.B,ASME B36.10,	PPA111300	
PIPE		18 - 20	SCH 80	BE	SMLS,API 5L GR.B,ASME B36.10,	PPA111300	
PIPE		22 - 24	SCH 80	BE	SMLS,API 5L GR.B,ASME B36.10,	PPA111300	
PIPE		1/2 - 3/4	SCH 80	PE	SMLS,API 5L GR.B,ASME B36.10,	PPA121300	
PIPE		1 - 1 1/4	SCH 80	PE	SMLS,API 5L GR.B,ASME B36.10,	PPA121300	
PIPE		1 1/2 - 1 1/2	SCH 80	PE	SMLS,API 5L GR.B,ASME B36.10,	PPA121300	
FLANGE							
LONG W.N.FLANGE		1 1/2 - 1 1/2	600#	WN-RF 125 AARH	CS ASTM A105,ASME B16.5,38mmBORE,200mmLONG	LN0270803	
W.N.FLANGE		1/2 - 24	600#	WN-RF 125 AARH	CS ASTM A105,ASME B16.5,WELD NECK	WN0270803	
SPACER AND BLIND		10 - 24	600#	RF 125 AARH	CS ASTM A105,ASME B16.48,	RS022P003	
SPECL BLIND		1/2 - 8	600#	RF 125 AARH	CS ASTM A105,ASME B16.48,	SP022P003	
BLIND FLANGE							
BLIND FLANGE		1/2 - 24	600#	RF 125 AARH	CS ASTM A105,ASME B16.5,	BF0220803	
GASKET							
GASKET		1/2 - 24	600#	SPRL-WND RF	TP304 SS WDG;GPH FLR;TP304 SS INR RNG;CS OTR RNG,ASME B16.20,	GSQN30303	
STUD & NUTS							
STUD & 2NUTS HVY		-			ASTM A193 GR.B7/ASTM A194 GR.2H,,	SNDE00000	
HEX							
FITTING (BW)							
BRANCH WELD		2 - 24		BW	CARBON STEEL,ASME B31.3,	RWOJ11200	
BRANCH WELD WITH		2 - 24		BW	CARBON STEEL,ASME B31.3,	WBOJ11200	
RP							
CAP		2 - 24		BW	ASTM A234 WPB-SMLS,ASME B16.9,	CP7310900	
ELBOW		2 - 24		BW	ASTM A234 WPB-SMLS,ASME B16.9,	EL7310900	
REDUCER CONC.		2 - 24		BW	ASTM A234 WPB-SMLS,ASME B16.9,	RC7310900	
REDUCER ECC.		2 - 24		BW	ASTM A234 WPB-SMLS,ASME B16.9,	RE7310900	
TEE		2 - 24		BW	ASTM A234 WPB-SMLS,ASME B16.9,	TE7310900	
WELDOLET		2 - 24		BW	CS ASTM A105,MSS SP 97,	WL0213300	
FITTING (SW)							
CAP		1/2 - 1 1/2	3000#	SOCW	CS ASTM A105,ASME B16.11,	CP0230207	W
COUPLING		1/2 - 1 1/2	3000#	SOCW	CS ASTM A105,ASME B16.11,	CN0230207	
ELBOW		1/2 - 1 1/2	3000#	SOCW	CS ASTM A105,ASME B16.11,	EL0230207	
HALF COUPLING		1/2 - 1 1/2	3000#	SOCW	CS ASTM A105,ASME B16.11,	HF0230207	
SOCKOLET		1/2 - 24	3000#	SOCW	CS ASTM A105,MSS SP 97,	SL0233307	
TEE		1/2 - 1 1/2	3000#	SOCW	CS ASTM A105,ASME B16.11,	TE0230207	
FITTING (THD)							
CAP		1/2 - 1 1/2	3000#	THD	CS ASTM A105,ASME B16.11,	CP0240207	T
PLUG		1/2 - 1 1/2		THD	CS ASTM A105,ASME B16.11,ROUND HEAD	PG0240200	
THREDOLET		1/2 - 24	3000#	THD	CS ASTM A105,MSS SP 97,	TL0243307	
NIPPLE							
NIPPLE		1/2 - 1 1/2	SCH160	PLN-PLN	SMLS,API 5L GR.B,ASME B36.10,	NPA151312	1
NIPPLE		1/2 - 1 1/2	SCH160	PLN-THD	SMLS,API 5L GR.B,ASME B36.10,NPT	NPA161312	2
NIPPLE		1/2 - 1 1/2	SCH160	THD	SMLS,API 5L GR.B,ASME B36.10,NPT	NPA141312	3
SWAGE NIPPLE							
SWAGE (CONC)		1/2 - 1 1/2		PE	ASTM A234 WPB-SMLS,MSS SP 95,	NC73J4500	P
SWAGE (CONC)		1/2 - 1 1/2		PLN-THD	ASTM A234 WPB-SMLS,MSS SP 95,	NC7364500	T
SWAGE (ECC)		1/2 - 1 1/2		PE	ASTM A234 WPB-SMLS,MSS SP 95,	NE73J4500	P



PIPING MATERIAL SPECIFICATION

CLIENT : M/S..TFL
 PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
 LOCATION : TALCHER,ODISHA

Project :TFL
 DOC. No.TFL-PDS-600
 Rev.:0

Class: F24

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE AW,HG,PA,PC,PN,SG	TEMPERATURE LIMITS (Deg.C)			
	Ref SI	Ref SI		

RATING ASME 600# RF	CORROSION ALLOWANCE 1.5 MM(MIN.)	MATERIAL CS			
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ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
SWAGE (ECC)		1/2 - 1 1/2		PLN-THD	ASTM A234 WPB-SMLS,MSS SP 95,	NE7364500	T
VALVES							
GATE VALVE		1 1/2 - 1 1/2	600#	FLG	CS BODY ASTM A216 GR WCB,GAV212,	GAV212	F
GATE VALVE		2 - 24	600#	FLG	CS BODY ASTM A216 GR WCB,GAV212,	GAV212	
GATE VALVE		1/2 - 1	800#	SOCW	CS BODY ASTM A105,GAV201,	GAV201	
GATE VALVE		1 1/2 - 1 1/2	800#	SOCW	CS BODY ASTM A105,GAV201,	GAV201	W
GLOBE VALVE		1/2 - 1 1/2	800#	SOCW	CS BODY ASTM A105,GLV201,	GLV201	
GLOBE VALVE		2 - 8	600#	FLG	CS BODY ASTM A216 GR WCB,GLV212,	GLV212	
CHECK VALVE		1/2 - 1 1/2	800#	SOCW	CS BODY ASTM A105,CHV201,	CHV201	
CHECK VALVE		2 - 16	600#	FLG	CS BODY ASTM A216 GR WCB,CHV212,	CHV212	
BALL VALVE		4 - 24	600#	FLG	CS BODY ASTM A216 GR WCB,BAV222,	BAV222	
NEEDLE VALVE		1/2 - 1/2	800#	SOCW	SS BODY ASTM A182 GR F316,NEV501,	NEV501	

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**PIPING MATERIAL SPECIFICATION**

CLIENT : M/S..TFL
 PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
 LOCATION : TALCHER,ODISHA

Project ..TFL
 DOC. No.TFL-PDS-600
 Rev.:0

Class: F24S

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE BB,BF,SM,SC (IBR)		TEMPERATURE LIMITS (Deg.C)					
		Ref SI	Ref SI				
RATING ASME 600# RF	CORROSION ALLOWANCE 1.5 MM(MIN.)	MATERIAL CS					
ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
PIPE							
PIPE		2 - 6	SCH 40	BE IBR	SMLS,ASTM A106 GR.B,ASME B36.10,	PP03A1300	
PIPE		8 - 10	SCH 60	BE IBR	SMLS,ASTM A106 GR.B,ASME B36.10,	PP03A1300	
PIPE		12 - 14	SCH 60	BE IBR	SMLS,ASTM A106 GR.B,ASME B36.10,	PP03A1300	
PIPE		16 - 18	SCH 60	BE IBR	SMLS,ASTM A106 GR.B,ASME B36.10,	PP03A1300	
PIPE		20 - 22	SCH 60	BE IBR	SMLS,ASTM A106 GR.B,ASME B36.10,	PP03A1300	
PIPE		24 - 24	SCH 60	BE IBR	SMLS,ASTM A106 GR.B,ASME B36.10,	PP03A1300	
PIPE		1/2 - 3/4	SCH 80	PE IBR	SMLS,ASTM A106 GR.B,ASME B36.10,	PP03B1300	
PIPE		1 - 11/4	SCH 80	PE IBR	SMLS,ASTM A106 GR.B,ASME B36.10,	PP03B1300	
PIPE		11/2 - 11/2	SCH 80	PE IBR	SMLS,ASTM A106 GR.B,ASME B36.10,	PP03B1300	
FLANGE							
LONG W.N.FLANGE		11/2 - 11/2	600#	WN-RF 125 AARH	CS ASTM A105,ASME B16.5,38mmBORE,200mmLONG	LN02G0803	
				IBR			
W.N.FLANGE		1/2 - 24	600#	WN-RF 125 AARH	CS ASTM A105,ASME B16.5,WELD NECK	WN02G0803	D
				IBR			
W.N.FLANGE		1/2 - 24	600#	WN-RJ IBR	CS ASTM A105,ASME B16.5,WELD NECK	WN02W0803	R
SPACER AND BLIND		10 - 24	600#	RF 125 AARH IBR	CS ASTM A105,ASME B16.48,	RS02BPO03	
SPECL BLIND		1/2 - 8	600#	RF 125 AARH IBR	CS ASTM A105,ASME B16.48,	SP02BPO03	
BLIND FLANGE							
BLIND FLANGE		1/2 - 24	600#	RF 125 AARH IBR	CS ASTM A105,ASME B16.5,	BF02B0803	
GASKET							
GASKET		1/2 - 24	600#	SPRL-WND RF	TP304 SS WDG;GPH FLR;TP304 SS INR RNG;CS OTR.RNG,ASME B16.20,	GSQN30303	
STUD & NUTS							
STUD & 2NUTS HVY		-			ASTM A193 GR.B7/ASTM A194 GR.2H,,	SNDE00000	
HEX							
FITTING (BW)							
BRANCH WELD		2 - 24		BW IBR	CARBON STEEL,ASME B31.3,	RWOJA1200	
BRANCH WELD WITH RP		2 - 24		BW IBR	CARBON STEEL,ASME B31.3,	WBOJA1200	
CAP		2 - 24		BW IBR	ASTM A234 WPB-SMLS,ASME B16.9,	CP73A0900	
ELBOW		2 - 24		BW IBR	ASTM A234 WPB-SMLS,ASME B16.9,	EL73A0900	
REDUCER CONC.		2 - 24		BW IBR	ASTM A234 WPB-SMLS,ASME B16.9,	RC73A0900	
REDUCER ECC.		2 - 24		BW IBR	ASTM A234 WPB-SMLS,ASME B16.9,	RE73A0900	
TEE		2 - 24		BW IBR	ASTM A234 WPB-SMLS,ASME B16.9,	TE73A0900	
WELDOLET		2 - 24		BW IBR	CS ASTM A105,MSS SP 97,	WL02A3300	
FITTING (SW)							
CAP		1/2 - 11/2	3000#	SOCW IBR	CS ASTM A105,ASME B16.11,	CP02C0207	W
COUPLING		1/2 - 11/2	3000#	SOCW IBR	CS ASTM A105,ASME B16.11,	CN02C0207	
ELBOW		1/2 - 11/2	3000#	SOCW IBR	CS ASTM A105,ASME B16.11,	EL02C0207	
HALF COUPLING		1/2 - 11/2	3000#	SOCW IBR	CS ASTM A105,ASME B16.11,	HF02C0207	
SOCKOLET		1/2 - 24	3000#	SOCW IBR	CS ASTM A105,MSS SP 97,	SL02C3307	
TEE		1/2 - 11/2	3000#	SOCW IBR	CS ASTM A105,ASME B16.11,	TE02C0207	
FITTING (THD)							
CAP		1/2 - 11/2	3000#	THD IBR	CS ASTM A105,ASME B16.11,	CP02D0207	T
PLUG		1/2 - 11/2		THD IBR	CS ASTM A105,ASME B16.11,ROUND HEAD	PG02D0200	
THREDOLET		1/2 - 24	3000#	THD IBR	CS ASTM A105,MSS SP 97,	TL02D3307	
NIPPLE							
NIPPLE		1/2 - 11/2	SCH160	PLN-PLN IBR	SMLS,ASTM A106 GR.B,ASME B36.10,	NP03E1312	1
NIPPLE		1/2 - 11/2	SCH160	PLN-THD IBR	SMLS,ASTM A106 GR.B,ASME B36.10,NPT	NP03F1312	2
NIPPLE		1/2 - 11/2	SCH160	THD IBR	SMLS,ASTM A106 GR.B,ASME B36.10,NPT	NP03D1312	3
SWAGE NIPPLE							
SWAGE (CONC)		1/2 - 11/2		PE IBR	ASTM A234 WPB-SMLS,MSS SP 95,	NC73Q4500	P



PIPING MATERIAL SPECIFICATION

CLIENT : M/S..TFL
 PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
 LOCATION : TALCHER,ODISHA

Project :TFL
 DOC. No.TFL-PDS-600
 Rev.:0

Class: F24S

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE BB,BF,SM,SC (IBR)	TEMPERATURE LIMITS (Deg.C)			
	Ref SI	Ref SI		
RATING ASME 600# RF	CORROSION ALLOWANCE 1.5 MM(MIN.)	MATERIAL CS		

ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
SWAGE (CONC)		1/2 - 11/2		PLN-THD IBR	ASTM A234 WPB-SMLS,MSS SP 95,	NC73F4500	T
SWAGE (ECC)		1/2 - 11/2		PE IBR	ASTM A234 WPB-SMLS,MSS SP 95,	NE73Q4500	P
SWAGE (ECC)		1/2 - 11/2		PLN-THD IBR	ASTM A234 WPB-SMLS,MSS SP 95,	NE73F4500	T
VALVES							
GATE VALVE		1/2 - 1	800#	SOCW IBR	CS BODY ASTM A105,GAV202S,	GAV202S	
GATE VALVE		11/2 - 11/2	800#	SOCW IBR	CS BODY ASTM A105,GAV202S,	GAV202S	W
GATE VALVE		11/2 - 11/2	600#	FLG IBR	CS BODY ASTM A216 GR WCB,GAV212S,	GAV212S	F
GATE VALVE		2 - 24	600#	FLG IBR	CS BODY ASTM A216 GR WCB,GAV212S,	GAV212S	
GLOBE VALVE		1/2 - 11/2	800#	SOCW IBR	CS BODY ASTM A105,GLV201S,	GLV201S	
GLOBE VALVE		2 - 12	600#	FLG IBR	CS BODY ASTM A216 GR WCB,GLV212S,	GLV212S	
CHECK VALVE		1/2 - 11/2	800#	SOCW IBR	CS BODY ASTM A105,CHV201S,	CHV201S	
CHECK VALVE		2 - 16	600#	FLG IBR	CS BODY ASTM A216 GR WCB,CHV212S,	CHV212S	
NEEDLE VALVE		1/2 - 1/2	800#	SOCW IBR	SS BODY ASTM A182 GR F316,NEV501S,	NEV501S	

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**PIPING MATERIAL SPECIFICATION**

CLIENT : M/S..TFL
 PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
 LOCATION : TALCHER,ODISHA

Project ..TFL
 DOC. No.TFL-PDS-600
 Rev.:0

Class: H24S

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE BB,BF,HS,SC (IBR)		TEMPERATURE LIMITS (Deg.C)					
		Ref SI	Ref SI				
RATING ASME 1500# RJ	CORROSION ALLOWANCE 1.5 MM(MIN.)	MATERIAL CS					
ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
PIPE							
PIPE		1/2 - 3/4	SCH160	PE IBR	SMLS,ASTM A106 GR.B,ASME B36.10,	PP03B1300	
PIPE		1 - 1 1/4	SCH160	PE IBR	SMLS,ASTM A106 GR.B,ASME B36.10,	PP03B1300	
PIPE		1 1/2 - 1 1/2	SCH160	PE IBR	SMLS,ASTM A106 GR.B,ASME B36.10,	PP03B1300	
PIPE		2 - 3	SCH160	BE IBR	SMLS,ASTM A106 GR.B,ASME B36.10,	PP03A1300	
PIPE		4 - 5	SCH120	BE IBR	SMLS,ASTM A106 GR.B,ASME B36.10,	PP03A1300	
PIPE		6 - 8	SCH120	BE IBR	SMLS,ASTM A106 GR.B,ASME B36.10,	PP03A1300	
PIPE		10 - 12	SCH140	BE IBR	SMLS,ASTM A106 GR.B,ASME B36.10,	PP03A1300	
PIPE		14 - 16	SCH140	BE IBR	SMLS,ASTM A106 GR.B,ASME B36.10,	PP03A1300	
PIPE		18 - 20	SCH140	BE IBR	SMLS,ASTM A106 GR.B,ASME B36.10,	PP03A1300	
PIPE		22 - 24	SCH140	BE IBR	SMLS,ASTM A106 GR.B,ASME B36.10,	PP03A1300	
FLANGE							
LONG W.N.FLANGE		1 1/2 - 1 1/2	1500#	WN-RJ IBR	CS ASTM A105,ASME B16.5,38mmBORE,200mmLONG	LN02W0805	
W.N.FLANGE		1/2 - 24	1500#	WN-RJ IBR	CS ASTM A105,ASME B16.5,WELD NECK	WN02W0805	
SPACER AND BLIND		8 - 24	1500#	WN-RJ IBR	CS ASTM A105,ASME B16.48,	RS02WPO05	
SPECL BLIND		1/2 - 6	1500#	WN-RJ IBR	CS ASTM A105,ASME B16.48,	SP02WPO05	
BLIND FLANGE							
BLIND FLANGE		1/2 - 24	1500#	WN-RJ IBR	CS ASTM A105,ASME B16.5,	BF02W0805	
GASKET							
GASKET		1/2 - 24	1500#	RJ OCT	SOFT IRON,ASME B16.20,	GS7940305	
STUD & NUTS							
STUD & 2NUTS HVY		-			ASTM A193 GR.B7/ASTM A194 GR.2H,,	SNDE00000	
HEX							
FITTING (BW)							
BRANCH WELD		2 - 24		BW IBR	CARBON STEEL,ASME B31.3,	RWOJA1200	
BRANCH WELD WITH		2 - 24		BW IBR	CARBON STEEL,ASME B31.3,	WBOJA1200	
RP							
CAP		2 - 24		BW IBR	ASTM A234 WPB-SMLS,ASME B16.9,	CP73A0900	
ELBOW		2 - 24		BW IBR	ASTM A234 WPB-SMLS,ASME B16.9,	EL73A0900	
REDUCER CONC.		2 - 24		BW IBR	ASTM A234 WPB-SMLS,ASME B16.9,	RC73A0900	
REDUCER ECC.		2 - 24		BW IBR	ASTM A234 WPB-SMLS,ASME B16.9,	RE73A0900	
TEE		2 - 24		BW IBR	ASTM A234 WPB-SMLS,ASME B16.9,	TE73A0900	
WELDOLET		2 - 24		BW IBR	CS ASTM A105,MSS SP 97,	WL02A3300	
FITTING (SW)							
CAP		1/2 - 1 1/2	6000#	SOCW IBR	CS ASTM A105,ASME B16.11,	CP02C0208	W
COUPLING		1/2 - 1 1/2	6000#	SOCW IBR	CS ASTM A105,ASME B16.11,	CN02C0208	
ELBOW		1/2 - 1 1/2	6000#	SOCW IBR	CS ASTM A105,ASME B16.11,	EL02C0208	
HALF COUPLING		1/2 - 1 1/2	6000#	SOCW IBR	CS ASTM A105,ASME B16.11,	HF02C0208	
SOCKOLET		1/2 - 24	6000#	SOCW IBR	CS ASTM A105,MSS SP 97,	SL02C3308	
TEE		1/2 - 1 1/2	6000#	SOCW IBR	CS ASTM A105,ASME B16.11,	TE02C0208	
FITTING (THD)							
CAP		1/2 - 1 1/2	6000#	THD IBR	CS ASTM A105,ASME B16.11,	CP02D0208	T
PLUG		1/2 - 1 1/2		THD IBR	CS ASTM A105,ASME B16.11,ROUND HEAD	PG02D0200	
THREDOLET		1/2 - 1 1/2	6000#	THD IBR	CS ASTM A105,MSS SP 97,	TL02D3308	
NIPPLE							
NIPPLE		1/2 - 1 1/2	SCHXXS	PLN-PLN IBR	SMLS,ASTM A106 GR.B,ASME B36.10,	NP03E1314	1
NIPPLE		1/2 - 1 1/2	SCHXXS	PLN-THD IBR	SMLS,ASTM A106 GR.B,ASME B36.10,NPT	NP03F1314	2
NIPPLE		1/2 - 1 1/2	SCHXXS	THD IBR	SMLS,ASTM A106 GR.B,ASME B36.10,NPT	NP03D1314	3
SWAGE NIPPLE							
SWAGE (CONC)		1/2 - 1 1/2		PE IBR	ASTM A234 WPB-SMLS,MSS SP 95,	NC73Q4500	P
SWAGE (CONC)		1/2 - 1 1/2		PLN-THD IBR	ASTM A234 WPB-SMLS,MSS SP 95,	NC73F4500	T
SWAGE (ECC)		1/2 - 1 1/2		PE IBR	ASTM A234 WPB-SMLS,MSS SP 95,	NE73Q4500	P



PIPING MATERIAL SPECIFICATION

CLIENT : M/S..TFL
 PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
 LOCATION : TALCHER,ODISHA

Project :TFL
 DOC. No.TFL-PDS-600
 Rev.:0

Class: H24S

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE BB,BF,HS,SC (IBR)	TEMPERATURE LIMITS (Deg.C)			
	Ref SI	Ref SI		
RATING ASME 1500# RJ	CORROSION ALLOWANCE 1.5 MM(MIN.)	MATERIAL CS		

ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
SWAGE (ECC)		1/2 - 1 1/2		PLN-THD IBR	ASTM A234 WPB-SMLS,MSS SP 95,	NE73F4500	T
VALVES							
GATE VALVE		1/2 - 1	1500#	SOCW IBR	CS BODY ASTM A105,GAV204S,	GAV204S	
GATE VALVE		1 1/2 - 24	1500#	BW IBR	CS BODY ASTM A216 GR WCB,GAV216S,	GAV216S	
GLOBE VALVE		1/2 - 1	1500#	SOCW IBR	CS BODY ASTM A105,GLV204S,	GLV204S	
GLOBE VALVE		1 1/2 - 8	1500#	BW IBR	CS BODY ASTM A216 GR WCB,GLV216S,	GLV216S	
CHECK VALVE		1/2 - 1	1500#	SOCW IBR	CS BODY ASTM A105,CHV204S,	CHV204S	
CHECK VALVE		1 1/2 - 24	1500#	BW IBR	CS BODY ASTM A216 GR WCB,CHV216S,	CHV216S	
NEEDLE VALVE		1/2 - 1/2	1500#	SOCW IBR	SS BODY ASTM A182 GR F316,NEV502S,	NEV502S	

:

**PIPING MATERIAL SPECIFICATION**

CLIENT : M/S..TFL
 PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
 LOCATION : TALCHER,ODISHA

Project ..TFL
 DOC. No.TFL-PDS-600
 Rev.:1

Class: J36S

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE SH,SC (IBR)	TEMPERATURE LIMITS (Deg.C)						
	Ref.SI	Ref.SI					
RATING ASME 2500#RJ	CORROSION ALLOWANCE 1.5 MM(MIN.)	MATERIAL AS					
ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
PIPE							
PIPE		1/2 - 3/4	SCHXXS	PE IBR	SMLS,ASTM A335 GR.P22,ASME B36.10,	PP34B1300	
PIPE		1 - 1 1/4	SCHXXS	PE IBR	SMLS,ASTM A335 GR.P22,ASME B36.10,	PP34B1300	
PIPE		1 1/2 - 1 1/2	SCHXXS	PE IBR	SMLS,ASTM A335 GR.P22,ASME B36.10,	PP34B1300	
PIPE		2 - 4	SCHXXS	BE IBR	SMLS,ASTM A335 GR.P22,ASME B36.10,	PP34A1300	
PIPE		6 - 6	24.00 MM	BE IBR	SMLS,ASTM A335 GR.P22,ASME B36.10,	PP34A1300	
PIPE		8 - 8	30.00 MM	BE IBR	SMLS,ASTM A335 GR.P22,ASME B36.10,	PP34A1300	
PIPE		10 - 10	38.00 MM	BE IBR	SMLS,ASTM A335 GR.P22,ASME B36.10,	PP34A1300	
PIPE		12 - 12	44.00 MM	BE IBR	SMLS,ASTM A335 GR.P22,ASME B36.10,	PP34A1300	
PIPE		14 - 14	48.00 MM	BE IBR	SMLS,ASTM A335 GR.P22,ASME B36.10,	PP34A1300	
PIPE		16 - 16	55.00 MM	BE IBR	SMLS,ASTM A335 GR.P22,ASME B36.10,	PP34A1300	
PIPE		18 - 18	62.00 MM	BE IBR	SMLS,ASTM A335 GR.P22,ASME B36.10,	PP34A1300	
PIPE		20 - 20	68.00 MM	BE IBR	SMLS,ASTM A335 GR.P22,ASME B36.10,	PP34A1300	
FLANGE							
LONG W.N.FLANGE		1/2 - 1 1/2	2500#	WN-RJ IBR	ASTM A182 F22,ASME B16.5, LONG WELD NECK	LN05W0806	
W.N.FLANGE		1/2 - 12	2500#	WN-RJ IBR	ASTM A182 F22,ASME B16.5,WELD NECK	WN05W0806	
SPACER AND BLIND		6 - 12	2500#	WN-RJ IBR	ASTM A182 F22,ASME B16.48,	RS05WP006	
SPECL BLIND		1 - 4	2500#	WN-RJ IBR	ASTM A182 F22,ASME B16.48,	SP05WP006	
BLIND FLANGE							
BLIND FLANGE		1/2 - 12	2500#	WN-RJ IBR	ASTM A182 F22,ASME B16.5,	BF05W0806	
GASKET							
GASKET		1/2 - 12	2500#	RJ OCT	ASTM A182 F5,ASME B16.20,	GSB340306	
STUD & NUTS							
STUD & 2NUTS HVY		-			ASTM A193 GR.B16/ASTM A194 GR.7.,,	SNB100000	
HEX							
FITTING (BW)							
BRANCH WELD		2 - 20		BW IBR	ALLOY STEEL,ASME B31.3,	RWE3A1200	
BRANCH WELD WITH RP		2 - 20		BW IBR	ALLOY STEEL,ASME B31.3,	WBE3A1200	
CAP		2 - 20		BW IBR	ASTM A234 WP22,ASME B16.9,	CPD2A0900	
ELBOW		2 - 20		BW IBR	ASTM A234 WP22,ASME B16.9,	ELD2A0900	
REDUCER CONC.		2 - 20		BW IBR	ASTM A234 WP22,ASME B16.9,	RCD2A0900	
REDUCER ECC.		2 - 20		BW IBR	ASTM A234 WP22,ASME B16.9,	RED2A0900	
TEE		2 - 20		BW IBR	ASTM A234 WP22,ASME B16.9,	TED2A0900	
WELDOLET		2 - 20		BW IBR	ASTM A182 F22,MSS SP 97,	WL05A3300	
FITTING (SW)							
CAP		1/2 - 1 1/2	9000#	SOCW IBR	ASTM A182 F22,ASME B16.11,	CP05C0209	W
COUPLING		1/2 - 1 1/2	9000#	SOCW IBR	ASTM A182 F22,ASME B16.11,	CN05C0209	
ELBOW		1/2 - 1 1/2	9000#	SOCW IBR	ASTM A182 F22,ASME B16.11,	EL05C0209	
HALF COUPLING		1/2 - 1 1/2	9000#	SOCW IBR	ASTM A182 F22,ASME B16.11,	HF05C0209	
SOCKOLET		1/2 - 20	6000#	SOCW IBR	ASTM A182 F22,MSS SP 97,	SL05C3308	
TEE		1/2 - 1 1/2	9000#	SOCW IBR	ASTM A182 F22,ASME B16.11,	TE05C0209	
FITTING (THD)							
CAP		1/2 - 1 1/2	6000#	THD IBR	ASTM A182 F22,ASME B16.11,	CP05D0208	T
PLUG		1/2 - 1 1/2		THD IBR	ASTM A182 F22,ASME B16.11,ROUND HEAD	PG05D0200	
THREDOLET		1/2 - 20	6000#	THD IBR	ASTM A182 F22,MSS SP 97,	TL05D3308	
NIPPLE							
NIPPLE		1/2 - 1 1/2	SCHXXS	PLN-PLN IBR	SMLS,ASTM A335 GR.P22,ASME B36.10,	NP34E1314	1
NIPPLE		1/2 - 1 1/2	SCHXXS	PLN-THD IBR	SMLS,ASTM A335 GR.P22,ASME B36.10,NPT	NP34F1314	2
NIPPLE		1/2 - 1 1/2	SCHXXS	THD IBR	SMLS,ASTM A335 GR.P22,ASME B36.10,NPT	NP34D1314	3
SWAGE NIPPLE							
SWAGE (CONC)		1/2 - 1 1/2		PE IBR	ASTM A234 WP22,MSS SP 95,	NCD2Q4500	P



PIPING MATERIAL SPECIFICATION

CLIENT : M/S..TFL
 PROJECT : AMMONIA/UREA COAL BASED FERTILIZER PROJECT.
 LOCATION : TALCHER,ODISHA

Project :TFL
 DOC. No.TFL-PDS-600
 Rev.:1

Class: J36S

PROJECTS AND DEVELOPMENT INDIA LIMITED

SERVICE SH.SC (IBR)	TEMPERATURE LIMITS (Deg.C)			
	Ref.SI	Ref.SI		
RATING ASME 2500#RJ	CORROSION ALLOWANCE 1.5 MM(MIN.)	MATERIAL AS		

ITEM	NOTES	SIZE (NPS)	SCH/ RAT	END	DESCRIPTION	COMM CODE	SPCL REV
SWAGE (CONC)		1/2 - 1 1/2		PLN-THD IBR	ASTM A234 WP22,MSS SP 95,	NCD2F4500	T
SWAGE (ECC)		1/2 - 1 1/2		PE IBR	ASTM A234 WP22,MSS SP 95,	NED2Q4500	P
SWAGE (ECC)		1/2 - 1 1/2		PLN-THD IBR	ASTM A234 WP22,MSS SP 95,	NED2F4500	T
VALVES							
GATE VALVE		1/2 - 1	2500#	SOCW IBR	CR-MO BODY ASTM A182 GR F22,GAV305S,	GAV305S	
GATE VALVE		1 1/2 - 1 1/2	2500#	SOCW IBR	CR-MO BODY ASTM A182 GR F22,GAV305S,	GAV305S	W
GATE VALVE		1 1/2 - 1 1/2	2500#	BW IBR	CR-MO BODY ASTM A217 GR WC9,GAV326S,	GAV326S	B
GATE VALVE		2 - 16	2500#	BW IBR	CR-MO BODY ASTM A217 GR WC9,GAV326S,	GAV326S	
GLOBE VALVE		1/2 - 1 1/2	2500#	SOCW IBR	CR-MO BODY ASTM A182 GR F22,GLV305S,	GLV305S	
GLOBE VALVE		2 - 8	2500#	BW IBR	CR-MO BODY ASTM A217 GR WC9,GLV326S,	GLV326S	
CHECK VALVE		1/2 - 1 1/2	2500#	SOCW IBR	CR-MO BODY ASTM A182 GR F22,CHV305S,	CHV305S	
CHECK VALVE		2 - 18	2500#	BW IBR	CR-MO BODY ASTM A217 GR WC9,CHV326S,	CHV326S	
NEEDLE VALVE		1/2 - 1/2	2500#	SOCW IBR	SS BODY ASTM A182 GR F316,NEV503S,	NEV503S	

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PROJECTS & DEVELOPMENT INDIA LTD

TFL-PDS-600

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DOCUMENT NO

REV

BRANCH TABLE : TABLE-A1

APPLICABLE PIPING MATERIAL SPECIFICATIONS: B14, D14, B20, B22IS, B24, D24, B24S, B24Z
PRESSURE RATING <= 300#

<-----B R A N C H S I Z E----->
 3 1 1 2 1 1 1 1 1 2 2 2 2 2 3 3 3 3 3 4 4 4 4 4 5 5 5 5 5
 M Q 1 Q M 2 M 3 4 6 8 0 2 4 6 8 0 2 4 6 8 0 2 4 6 8 0 2 4 6 8 0 2 4 6 8

M T
 3Q E T
 1 E E T
 1Q
 1M E E E T
 2 S S S E T
 2M S S S E E T
 3 S S S E E E T
 4 S S S S E E E T
 6 S S S S W W E E T
 8 S S S S W W W E E T
 10 S S S S W W W W E E T
 12 S S S S W W W W W E E T
 14 S S S S W W W W W W E E T
 16 S S S S W W W W W W P E E T
 18 S S S S W W W W W W P P E E T
 20 S S S S W W W W W W P P P E E T
 22 S S S S W W W W W W P P P P E E T
 24 S S S S W W W W W W P P P P P E E T
 26 S S S S P P P P P P P P P P P E E T
 28 S S S S P P P P P P P P P P P P E E T
 30 S S S S P P P P P P P P P P P P P E E T
 32 S S S S P P P P P P P P P P P P P P E E T
 34 S S S S P P P P P P P P P P P P P P P E E T
 36 S S S S P P P P P P P P P P P P P P P P E E T
 38 S S S S P P P P P P P P P P P P P P P P P E E T
 40 S S S S P P P P P P P P P P P P P P P P P P E E T
 42 S S S S P P P P P P P P P P P P P P P P P P P E E T
 44 S S S S P E E T
 46 S S S S P E E T
 48 S S S S P E E T
 50
 52
 54
 56
 58
 A-

E TE REDUCING TEE
 P WB BRANCH WELD WITH RP
 S SL SOCKOLET
 T TE EQUAL TEE
 W WL WELDOLET



BRANCH TABLE: TABLE-A2

**APPLICABLE PIPING MATERIAL SPECIFICATIONS: B40,B50,B52,D50,D52 .
PRESSURE RATING <=300#**

<-----B R A N C H S I Z E----->
 3 1 1 2 1 1 1 1 1 2 2 2 2 2 3 3 3 3 3 4 4 4 4 4 5 5 5 5 5
 M Q 1 Q M 2 M 3 4 6 8 0 2 4 6 8 0 2 4 6 8 0 2 4 6 8 0 2 4 6 8 0 2 4 6 8

M T
 3Q E T
 1 E E T
 1Q
 1M E E E T
 2 S S S E T
 2M
 3 S S S E E T
 4 S S S S E E T
 6 S S S S P E E T
 8 S S S S P P E E T
 10 S S S S P P P E E T
 12 S S S S P P P P E E T
 14 S S S S P P P P P E E T
 16 S S S S P P P P P P E E T
 18 S S S S P P P P P P P E E T
 20 S S S S P P P P P P P P E E T
 22 S S S S P P P P P P P P P E E T
 24 S S S S P P P P P P P P P P E E T
 26 S S S S P P P P P P P P P P P E E T
 28 S S S S P P P P P P P P P P P P E E T
 30 S S S S P P P P P P P P P P P P P E E T
 32 S S S S P P P P P P P P P P P P P P E E T
 34 S S S S P P P P P P P P P P P P P P P E E T
 36 S S S S P P P P P P P P P P P P P P P P E E T
 38 S S S S P P P P P P P P P P P P P P P P P E E T
 40 S S S S P P P P P P P P P P P P P P P P P P E E T
 42 S S S S P P P P P P P P P P P P P P P P P P P E E T
 44 S S S S P E E T
 46 S S S S P E E T
 48 S S S S P E E T
 50
 52
 54
 56
 58
 A-

E TE REDUCING TEE
 P WB BRANCH WELD WITH RP
 S SL SOCKOLET
 T TE EQUAL TEE

	PROJECTS & DEVELOPMENT INDIA LTD	TFL-PDS-600	1
		DOCUMENT NO	REV

BRANCH TABLE : TABLE-A3

APPLICABLE PIPING MATERIAL

SPECIFICATIONS: **F24, F24S, H24S, J36S**

<-----B R A N C H S I Z E----->

3 1 1 2 1 1 1 1 1 2 2 2 2 2 3 3 3 3 3 4 4 4 4 4 5 5 5 5 5

M Q 1 Q M 2 M 3 4 6 8 0 2 4 6 8 0 2 4 6 8 0 2 4 6 8 0 2 4 6 8 0 2 4 6 8

M T
3Q E T
1 E E T
1Q
1M E E E T
2 S S S E T
2M
3 S S S E E T
4 S S S S E E T
6 S S S S W E E T
8 S S S S W W E E T
10 S S S S W W W E E T
12 S S S S W W W W E E T
14 S S S S W W W W E E T
16 S S S S W W W W W E E T
18 S S S S W W W W W W E E T
20 S S S S W W W W W W W E E T
22 S S S S W W W W W W W W E E T
24 S S S S W W W W W W W W W E E T
26 S S S S W W W W W W W W W W E E T
28 S S S S W W W W W W W W W W W E E T
30 S S S S W W W W W W W W W W W W E E T
32 S S S S W W W W W W W W W W W W W E E T
34 S S S S W W W W W W W W W W W W W W E E T
36 S S S S W W W W W W W W W W W W W W W E E T
38
40
42
44
46
48
50
52
54
56
58
A-

E TE TEE
S SL SOCKOLET
T TE TEE
W WL WELDOLET

	PROJECTS & DEVELOPMENT INDIA LTD	TFL-PDS-600	0
		DOCUMENT NO	REV

BRANCH TABLE : TABLE-R1

**APPLICABLE PIPING MATERIAL SPECIFICATIONS :B22G,B22ISG,B24G,B24RL,B24FL.
PRESSURE RATING <= 300#**

<-----B R A N C H S I Z E----->
 3 1 1 2 1 1
 M Q 1 Q M 2 M 3 4 6 8 0 2

M
3Q
1 T
1Q
1M E T
2 E E T
2M
3 E E E T
4 E E E E T
6 E E E E E T
8 E E E E E E T
10 E E P P E E E T
12 E E P P P E E E T

A-

E TE REDUCING TEE
P WB BRANCH WELD WITH RP
T TE EQUAL TEE



PROJECTS & DEVELOPMENT INDIA LTD

TFL-PDS-600

0

DOCUMENT NO

REV

BRANCH TABLE : TABLE-R2

APPLICABLE PIPING MATERIAL SPECIFICATIONS: B24D, B24P.

PRESSURE RATING <= 300#

<-----B R A N C H S I Z E----->

	3	1	1	2				1	1
	M	Q	1	Q	M	2	M	3	4
	6	8	0	2					
M									
3Q									
1									
1Q									
1M									
2					T				
2M									
3					E	T			
4					E	E	T		
6					E	E	E	T	
8					E	E	E	E	T
10					E	E	E	E	E
12					E	E	E	E	E

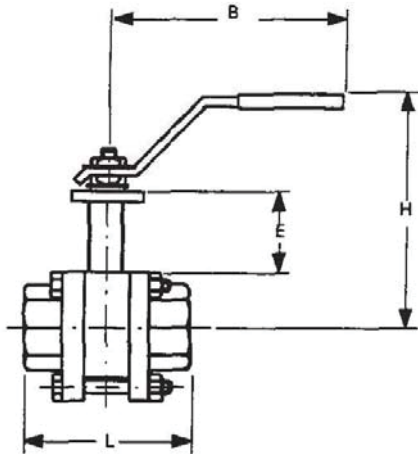
A-

E TE REDUCING TEE
T TE EQUAL TEE

 PROJECTS & DEVELOPMENT INDIA LTD	TFL-PDS-600	1
	DOCUMENT NO	REV

VALVE DATA SHEETS

BALL VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	BAV 101
PRESSURE RATING CLASS	800
FACE	SW
CONSTRUCTION	
BODY	THREE PIECES TYPE FULL BORE FLOATING BALL
EXTENDED STEM	YES b)
WRENCH OPERATED	YES
GEAR OPERATED	NO
FIRE SAFE	YES
NOMINAL SIZE	1/2" - 1 1/2"
MATERIALS	
BODY	A 350 Gr. LF2
BALL	AISI 316
BODY SEAT RING	PTFE
STEM PACKING	PTFE GRAPHITE
STEM	13 Cr.
DESIGN CONDITIONS	
PRESSURE RATING	API 602
FLUID	Kg/cm ² g °C

GENERAL

1. COPPER AND COPPER ALLOYS NDT PERMITTED
- 2.
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE

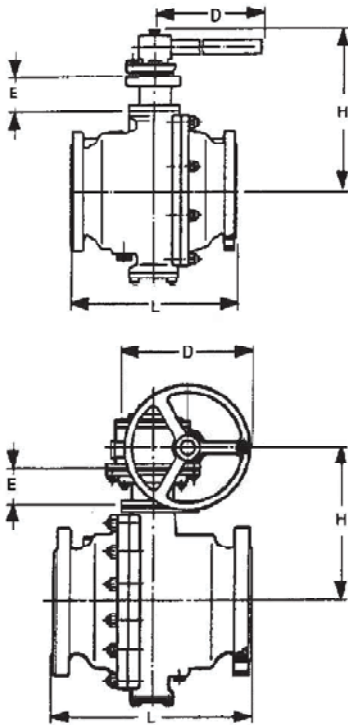
MANDATORY STANDARDS:

API 598, API 602, API 607, API 608, ANSI B16.11, ANSI B16.34

NOTES:

- a) SEAT RATING ACC. TO MANUFACTURER'S STANDARD
- b) STEM EXTENSION E = 120MM (FOR MAX. 70MM COLD INSULATION)

BALL VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	BAV 111	
PRESSURE RATING CLASS	300	
FACE	RF	
CONSTRUCTION		
BODY	SPLIT BODY, FULL BORE FLOATING BALL = < 4" TRUN. MOUNT BALL > 4" LONG PATTERN	
EXTENDED STEM	YES b)	
WRENCH OPERATED	1 1/2" - 6"	
GEAR OPERATED	8" - 14"	
FIRE SAFE	YES	
NOMINAL SIZE	1 1/2" - 14"	
MATERIALS		
BODY	A 352 Gr. LCB	
BALL	AISI 316 OR C.S. CHROMEPLATED	
BODY SEAT RING	PTFE	
STEM PACKING	PTFE GRAPHITE	
STEM	13 Cr.	
DESIGN CONDITIONS		
PRESSURE RATING	ANSI B16.34	
FLUID	Kg/cm ² g	°C

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
- 2.
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE

MANDATORY STANDARDS:

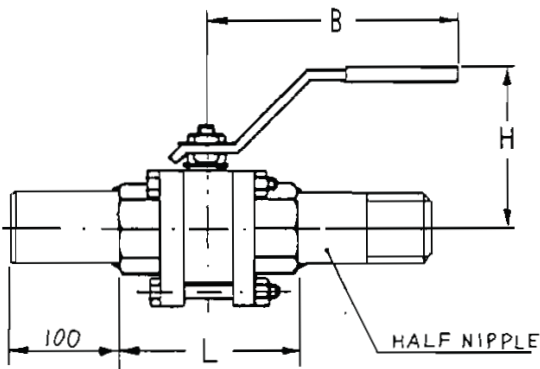
API 598, API 607, API 608, ANSI B16.10, ANSI B16.34, ANSI B16.5

NOTES:

- a) SEAT RATING ACC. TO MANUFACTURER'S STANDARD
- b) STEM EXTENSION E = 150mm (FOR MAX 100mm COLD INSULATION)



BALL VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	BAV 201
PRESSURE RATING CLASS	800
FACE	SW b)
CONSTRUCTION	
BODY	THREE PIECES TYPE FULL BORE FLOATING BALL
EXTENDED STEM	NO
WRENCH OPERATED	YES
GEAR OPERATED	NO
FIRE SAFE	YES
NOMINAL SIZE	1/2" - 1 1/2"
MATERIALS	
BODY	A 105
BALL	AISI 316
BODY SEAT RING	PTFE
STEM PACKING	PTFE GRAPHITE
STEM	13 Cr.
DESIGN CONDITIONS	
PRESSURE RATING	API 602

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. IF OTHERWISE STATED THE VALVES SHALL BE FULL BORE

MANDATORY STANDARDS:

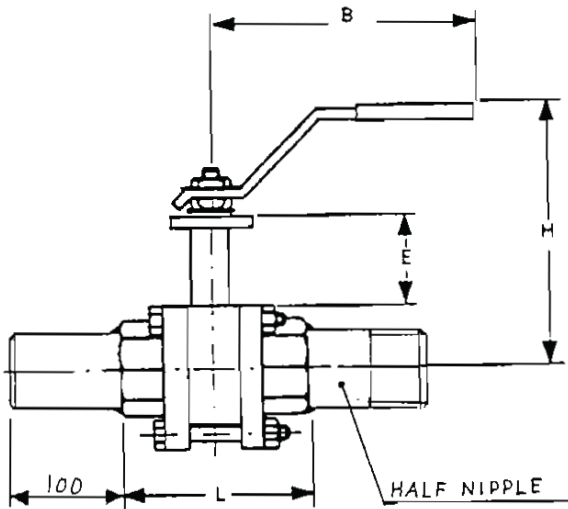
API 598, API 602, API 607, API 608, ANSI B16.11, ANSI B16.34

NOTES:

- a) SEAT RATING ACC. TO MANUFACTURER'S STANDARD
- b) VALVE PROVIDED WITH EXTENDED ENDS, 100mm LONG SCH 80/HALF NIPPLE



BALL VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	BAV 202
PRESSURE RATING CLASS	800
FACE	SW c)
CONSTRUCTION	
BODY	THREE PIECES TYPE FULL BORE FLOATING BALL
EXTENDED STEM	YES b)
WRENCH OPERATED	YES
GEAR OPERATED	NO
FIRE SAFE	YES
NOMINAL SIZE	1/2" - 1 1/2"
MATERIALS	
BODY	A 105
BALL	AISI 316
BODY SEAT RING	PTFE
STEM PACKING	PTFE GRAPHITE
STEM	13 Cr.
DESIGN CONDITIONS	
PRESSURE RATING	API 602

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. IF OTHERWISE STATED THE VALVES SHALL BE FULL BORE

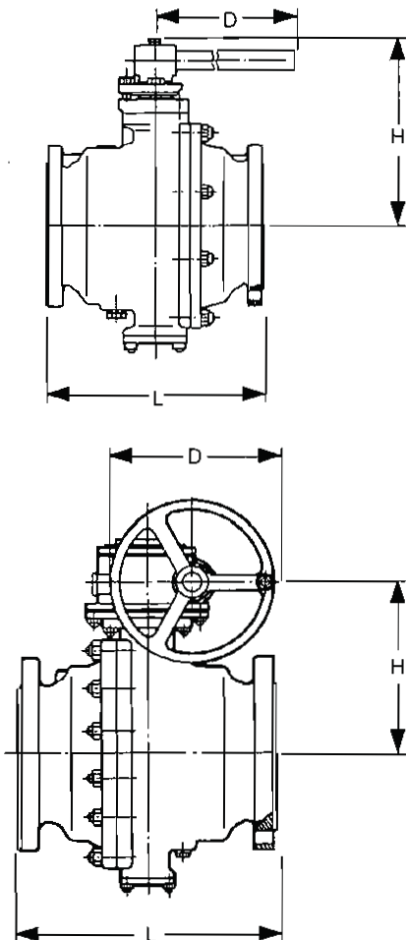
MANDATORY STANDARDS:

API 598, API 602, API 608, ANSI B16.11, ANSI B16.34

NOTES:

- a) SEAT RATING ACC. TO MANUFACTURER'S STANDARD
- b) STEM EXTENSION E= 120mm (FOR MAX. 70mm COLD INSULATION)
- c) VALVE PROVIDED WITH EXTENDED ENDS, 100mm LONG SCH 80/HALF NIPPLE

BALL VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	BAV 210	
PRESSURE RATING CLASS	150	
FACE	RF	
CONSTRUCTION		
BODY	SPLIT BODY, FULL BORE FLOATING BALL = < 4" TRUN. MOUNT BALL > 4" LONG PATTERN	
EXTENDED STEM	NO	
WRENCH OPERATED	2" - 6"	
GEAR OPERATED	8" - 24"	
FIRE SAFE	YES	
NOMINAL SIZE	2" - 24"	
MATERIALS		
BODY	A 216 Gr. WCB	
BALL	AISI 316 OR C.S. CHROMEPLATED	
BODY SEAT RING	PTFE	
STEM PACKING	PTFE GRAPHITE	
STEM	13 Cr.	
DESIGN CONDITIONS		
PRESSURE RATING	ANSI B16.34	
FLUID	Kg/cm ² g	°C

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE

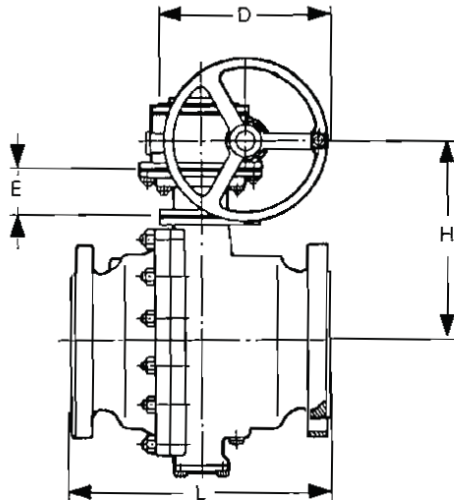
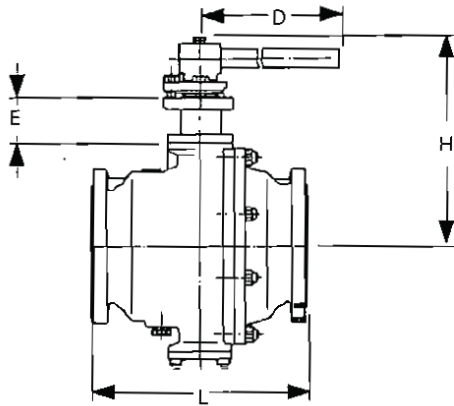
MANDATORY STANDARDS:

API 598, API 607, API 608, ANSI B16.10, ANSI B16.34, ANSI B16.5

NOTES:

- a) SEAT RATING ACC. TO MANUFACTURER'S STANDARD

BALL VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	BAV 211
PRESSURE RATING CLASS	300
FACE	RF
CONSTRUCTION	
BODY	SPLIT BODY, FULL BORE FLOATING BALL = < 4" TRUN. MOUNT BALL > 4" LONG PATTERN
EXTENDED STEM	YES b)
WRENCH OPERATED	2" - 6"
GEAR OPERATED	8" - 12"
FIRE SAFE	YES
NOMINAL SIZE	2" - 12"
MATERIALS	
BODY	A 216 Gr. WCB
BALL	AISI 316 OR C.S. CHROMEPLATED
BODY SEAT RING	PTFE
STEM PACKING	PTFE GRAPHITE
STEM	13 Cr.
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE

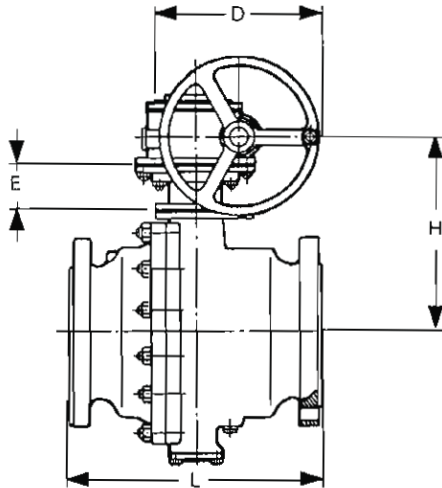
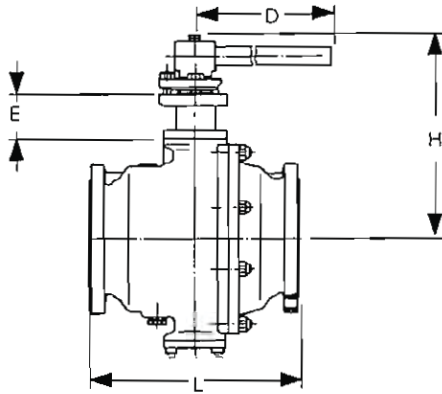
MANDATORY STANDARDS:

API 598, API 607, API 608, ANSI B16.10, ANSI B16.34, ANSI B16.5

NOTES:

- a) SEAT RATING ACC. TO MANUFACTURER'S STANDARD
- b) STEM EXTENSION E = 120mm (FOR MAX 70mm COLD INSULATION)

BALL VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	BAV 222	
PRESSURE RATING CLASS	600	
FACE	RF	
CONSTRUCTION		
BODY	SPLIT BODY FULL BORE TRUNNION MOUNTED BALL LONG PATTERN	
EXTENDED STEM	NO	
WRENCH OPERATED	NO	
GEAR OPERATED	YES	
FIRE SAFE	YES	
NOMINAL SIZE	8" - 24"	
MATERIALS		
BODY	A 216 Gr. WCB	
BALL	A 351 Gr. CF 8M OR CS CHROMEPLATED	
BODY SEAT RING	AISI 316 STELLITED	
STEM PACKING	PTFE GRAPHITE	
STEM	AISI 316	
DESIGN CONDITIONS		
PRESSURE RATING	ANSI B16.34	
FLUID	Kg/cm2g	°C

rev.1

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
- 2.
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE

MANDATORY STANDARDS:

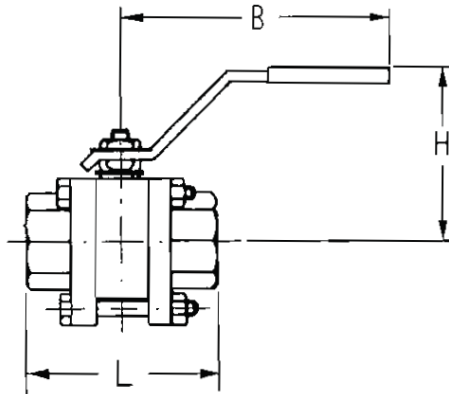
API 598, API 607, API 608, ANSI B16.10, ANSI B16.34, ANSI B16.5

NOTES:

- a) SEAT RATING ACC. TO MANUFACTURER'S STANDARD
- b) STEM EXTENSION E = 150 mm



BALL VALVE



ITEM NO	BAV 501
PRESSURE RATING CLASS	800
FACE	THREADED (NPT)
CONSTRUCTION	
BODY	THREE PIECES TYPE FULL BORE FLOATING BALL
EXTENDED STEM	NO
WRENCH OPERATED	YES
GEAR OPERATED	NO
FIRE SAFE	YES
NOMINAL SIZE	1/2" - 1 1/2"
MATERIALS	
BODY	AISI 316
BALL	AISI 316
BODY SEAT RING	PTFE
STEM PACKING	PTFE GRAPHITE
STEM	AISI 316
DESIGN CONDITIONS	
PRESSURE RATING	API 602

DESIGN (ILLUSTRATIVE ONLY)

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE

MANDATORY STANDARDS:

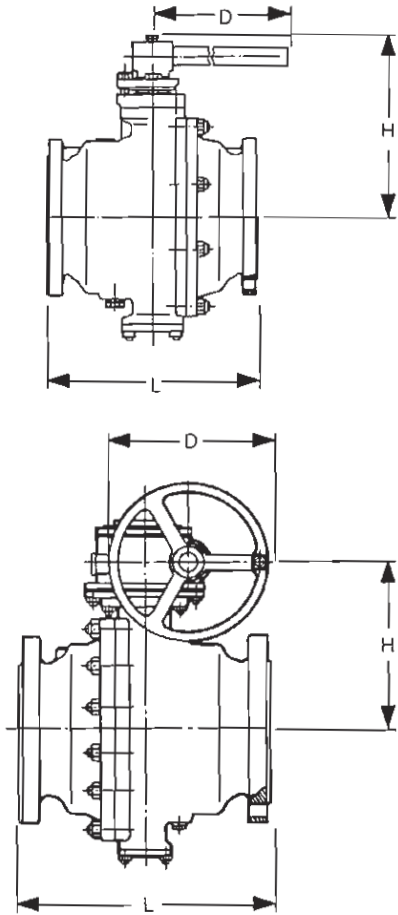
API 598, API 602, API 607, API 608, ANSI B16.11, ANSI B16.34

NOTES:

- a) SEAT RATING ACC. TO MANUFACTURER'S STANDARD
- b) BOTH ENDS FEMALE SCREWED



BALL VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	BAV 510
PRESSURE RATING CLASS	150
FACE	RF
CONSTRUCTION	
BODY	SPLIT BODY, FULL BORE, FLOATING BALL = < 4" TRUN. MOUNT BALL > 4" LONG PATTERN
EXTENDED STEM	NO
WRENCH OPERATED	2" - 6"
GEAR OPERATED	8" - 12"
FIRE SAFE	YES
NOMINAL SIZE	2" - 12"
MATERIALS	
BODY	A 351 Gr. CF 8M
BALL	AISI 316
BODY SEAT RING	PTFE
STEM PACKING	PTFE GRAPHITE
STEM	AISI 316
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE

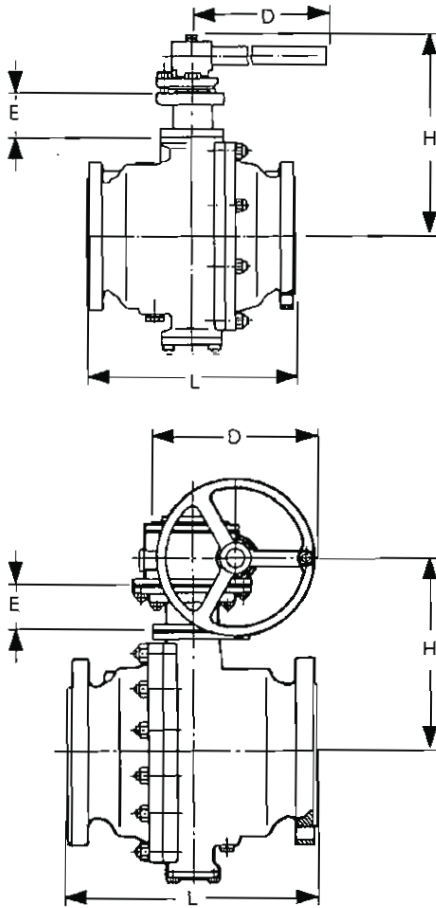
MANDATORY STANDARDS:

API 598, API 607, API 608, ANSI B16.10, ANSI B16.34, ANSI B16.5

NOTES:

- a) SEAT RATING ACC. TO MANUFACTURER'S STANDARD

BALL VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	BAV 520
PRESSURE RATING CLASS	150
FACE	RF
CONSTRUCTION	
BODY	SPLIT BODY FULL BORE TRUNNION MOUNTED BALL LONG PATTERN
EXTENDED STEM	NO
WRENCH OPERATED	NO
GEAR OPERATED	YES
FIRE SAFE	YES
NOMINAL SIZE	8" - 24"
MATERIALS	
BODY	A 351 Gr. CF 8M
BALL	A 351 Gr. CF 8M or CS Chromeplated
BODY SEAT RING	AISI 316 STELLITED
STEM PACKING	PTFE GRAPHITE
STEM	AISI 316
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE

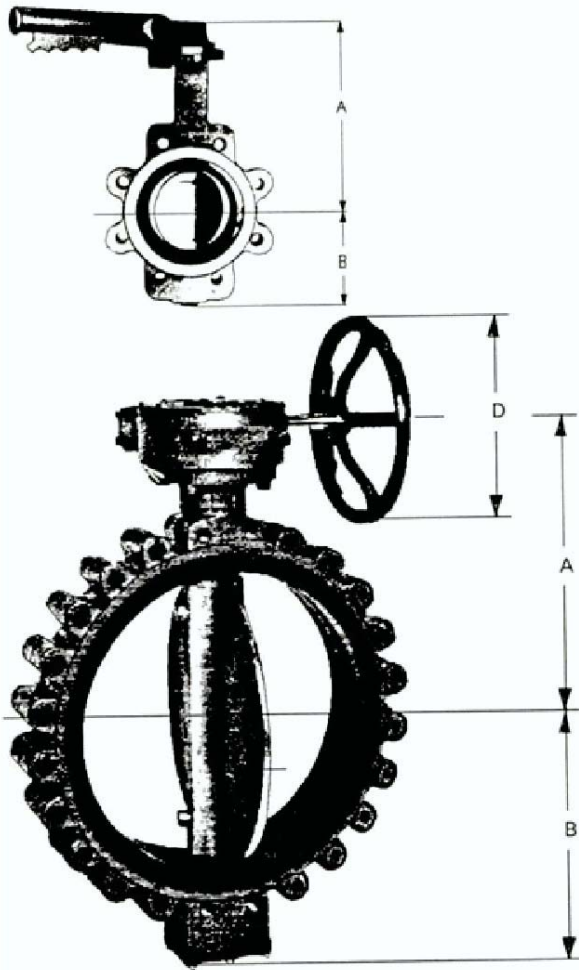
MANDATORY STANDARDS:

API 598, API 607, API 608, ANSI B16.10, ANSI B16.34, ANSI B16.5

NOTES:

- a) SEAT RATING ACC. TO MANUFACTURER'S STANDARD
- b) STEM EXTENSION E = 150mm

BUTTERFLY VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	BUV 101	
PRESSURE RATING CLASS	150	
FACE	RF	
CONSTRUCTION		
BODY	LUG TYPE WITH THREADED HOLES	
	METAL SEATED	
	CATEGORY "B"	
GEAR OPERATED	> = 8"	
NOMINAL SIZE	2" - 20"	
MATERIALS		
BODY	A 352 Gr. LCB	
BODY SEAT	A 182 F304	
DISC	AISI 304 STELLITED	
SHAFT	AISI 304	
SHAFT PACKING	GRAPHITE	
DESIGN CONDITIONS		
PRESSURE RATING	ANSI B16.34	
FLUID	Kg/cm2g	°C
LIQUID LPG/PROPANE/BUTANE	3.5	- 45

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. FACE-TO-FACE DIMENSIONS SHALL BE PER API 609

MANDATORY STANDARDS:

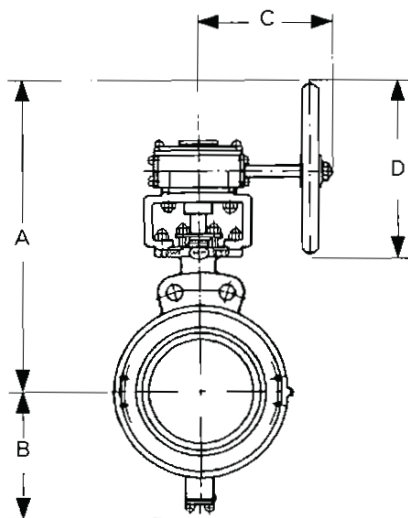
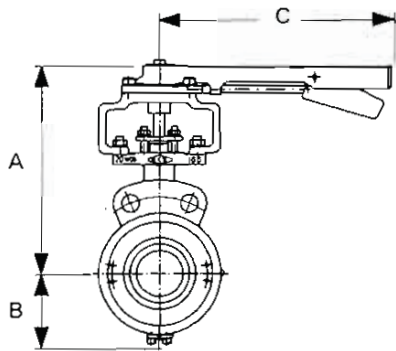
API 609, ANSI B16.34, ANSI B16.5

NOTES:

- a) EXTENDED SHAFT TO BE PROVIDED FOR VALVES WITH GEARBOX TO AVOID HEATING OF GEARBOX



BUTTERFLY VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	BUV 202
PRESSURE RATING CLASS	300
FACE	RF
CONSTRUCTION	
BODY	WAFER TYPE
	METAL SEATED
	CATEGORY "B"
GEAR OPERATED	> = 8"
NOMINAL SIZE	3" - 24"
MATERIALS	
BODY	A 216 Gr. WCB
BODY SEAT	A 182 Gr. F6a
DISC	A 216 Gr. WCB HARD FACED
SHAFT	13 Cr.
SHAFT PACKING	GRAFOIL
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. FACE-TO-FACE DIMENSIONS SHALL BE PER API 609

MANDATORY STANDARDS:

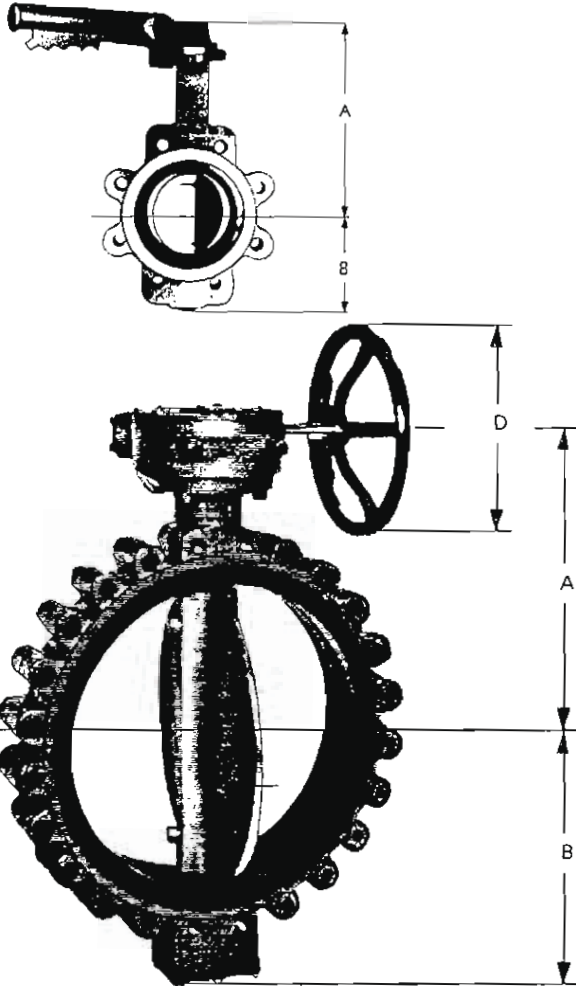
API 609, ANSI B16.34, ANSI B16.5

NOTES:

- a) EXTENDED SHAFT TO BE PROVIDED FOR VALVES WITH GEARBOX TO AVOID HEATING OF GEARBOX



BUTTERFLY VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	BUV 203
PRESSURE RATING CLASS	150
FACE	RF
CONSTRUCTION	
BODY	CAST
	LUG TYPE WITH
	THREADED HOLES
	RUBBER LINED
GEAR OPERATED	YES > = 8"
NOMINAL SIZE	2" - 24"
MATERIALS	
BODY	A 216 Gr. WCB
BODY LINING	ETHYLENE-PROPYLENE
DISC	A216 GR.WCB+
SHAFT	13 Cr
SHAFT PACKING	PTFE
DESIGN CONDITIONS	
PRESSURE RATING	API 609

rev.1

GENERAL

1. RUBBER LINING: THE WETTED SURFACES OF VALVE SHALL BE FULLY LINED AND THE LINING SHALL EXTEND OVER THE FLANGE SEALING FACE
2. LEVER OPERATORS SUITABLE FOR THROTTLING PURPOSES SHALL BE PROVIDED FOR VALVES 6" AND SMALLER
3. FACE-TO-FACE DIMENSIONS SHALL BE PER API 609
4. COPPER AND COPPER ALLOYS NOT PERMITTED

MANDATORY STANDARDS:

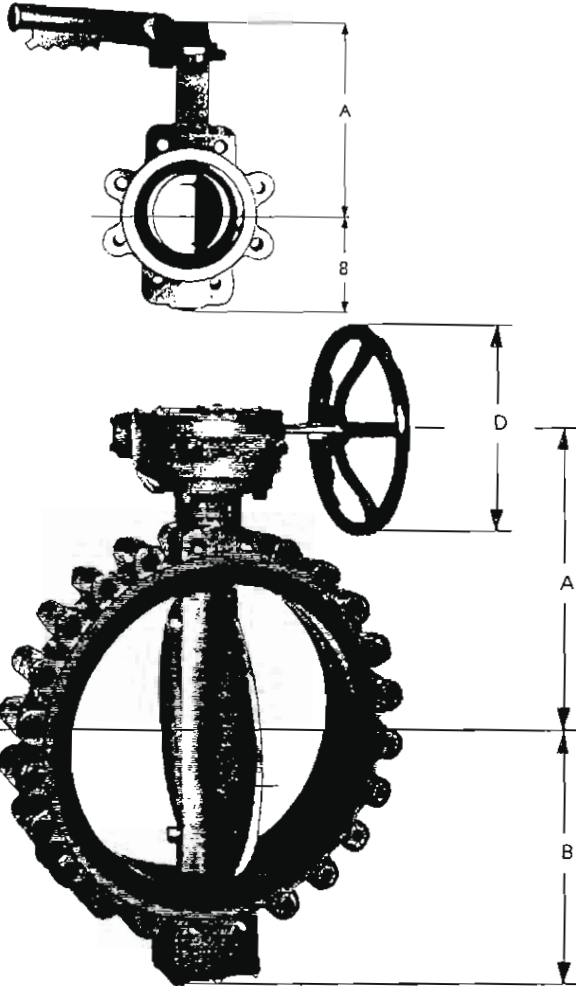
API 609, ANSI B16.5

NOTES:

- a) THE VALVE SHALL BE DESIGNED FOR CLOSURE IN DEAD-END-PIPING



BUTTERFLY VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	BUV 203 RL
PRESSURE RATING CLASS	150
FACE	RF
CONSTRUCTION	
BODY	CAST
	LUG TYPE WITH
	THREADED HOLES
	RUBBER LINED
GEAR OPERATED	YES > = 8"
NOMINAL SIZE	2" - 24"
MATERIALS	
BODY	A 216 Gr. WCB
BODY LINING	ETHYLENE-PROPYLENE
DISC	A216 GR.WCB+ RUBBER LINED
SHAFT	13 Cr
SHAFT PACKING	PTFE
DESIGN CONDITIONS	
PRESSURE RATING	API 609

rev.1

rev.1

GENERAL

1. RUBBER LINING: THE WETTED SURFACES OF VALVE SHALL BE FULLY LINED AND THE LINING SHALL EXTEND OVER THE FLANGE SEALING FACE
2. LEVER OPERATORS SUITABLE FOR THROTTLING PURPOSES SHALL BE PROVIDED FOR VALVES 6" AND SMALLER
3. FACE-TO-FACE DIMENSIONS SHALL BE PER API 609
4. COPPER AND COPPER ALLOYS NOT PERMITTED

MANDATORY STANDARDS:

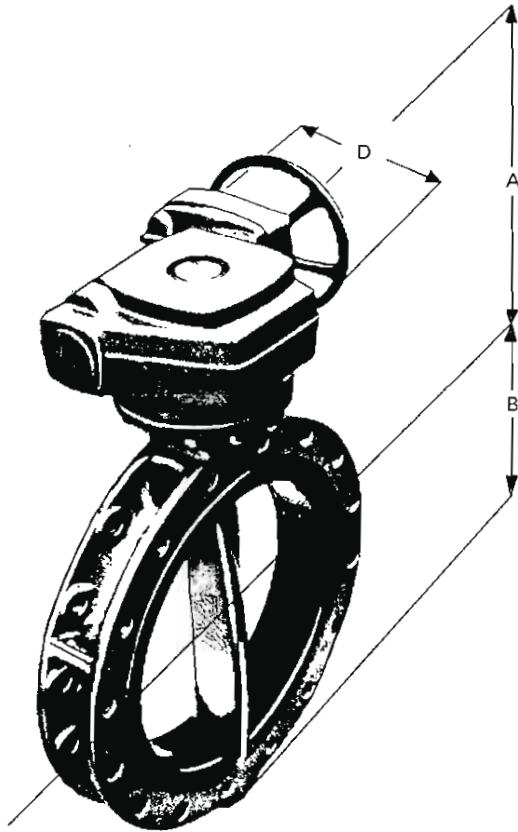
API 609, ANSI B16.5

NOTES:

- a) THE VALVE SHALL BE DESIGNED FOR CLOSURE IN DEAD-END-PIPING
- b) THIS VALVE SHALL BE RUBBERLINED FOR CORROSSIVE SERVICE.



BUTTERFLY VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	BUV 204
PRESSURE RATING CLASS	150
FACE	RF
CONSTRUCTION	
BODY	FLANGED SHORT BODY
	FULL-DRILLED
	BOLTHOLES IN FLANGES
	RUBBER LINED
GEAR OPERATED	YES
NOMINAL SIZE	26" - 64"
MATERIALS	
BODY	A 216 Gr. WCB
BODY LINING	ETHYLENE-PROPYLENE
DISC	A216 GR.WCB+ RUBBER LINED
SHAFT	13 Cr
SHAFT PACKING	PTFE
DESIGN CONDITIONS	
PRESSURE RATING	ASME B16.47

rev.1

rev.1

GENERAL

1. RUBBER LINING: THE WETTED SURFACES OF VALVE SHALL BE FULLY LINED AND LINING SHALL EXTEND OVER THE FLANGE SEALING FACE
2. FACE-TO-FACE DIMENSIONS SHALL BE PER AWWA C 504 SHORT-BODY
3. COPPER AND COPPER ALLOYS NOT PERMITTED

MANDATORY STANDARDS:

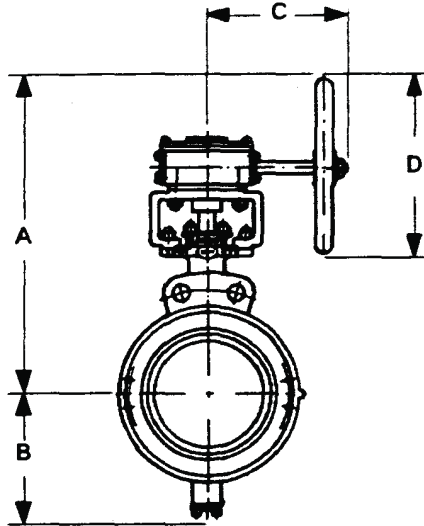
AWWA C 504, ASME B16.47

NOTES:

- a) THE VALVE SHALL BE DESIGNED FOR CLOSURE IN DEAD-END-PIPING
- b) FLANGES ACC. TO ASME B16.47 SERIES B



BUTTERFLY VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	BUY 410
PRESSURE RATING CLASS	150
FACE	RF
CONSTRUCTION	
BODY	WAFER TYPE
	CATEGORY "B"
GEAR OPERATED	> = 8"
NOMINAL SIZE	6" - 48"
MATERIALS	
BODY	A351 Gr.CF3M
BODY SEAT	REINFORCED PTFE a)
DISC	SS316L
SHAFT	A276 Gr.316L
SHAFT PACKING	PTFE
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. FACE-TO-FACE DIMENSIONS SHALL BE PER API 609

MANDATORY STANDARDS:

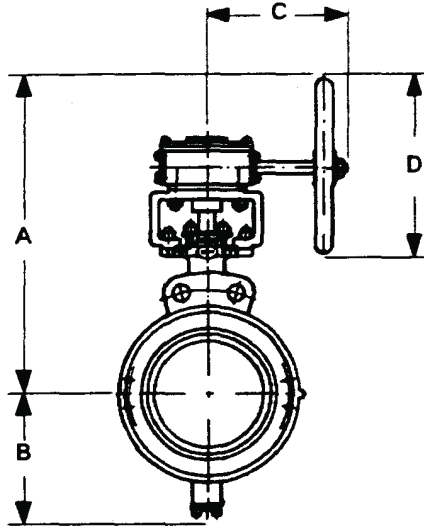
API 609, ANSI B16.34, ANSI B16.47, ANSI B16.5

NOTES:

- a) MANUFACTURER MAY RECOMMEND ALTERNATIVE SEAT MATERIAL AND SEAT RATING SUBJECT TO PURCHASER APPROVAL
- b) FLANGES > 24" ACC. TO ASME B16.47 SERIES B



BUTTERFLY VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	BUY 411
PRESSURE RATING CLASS	300
FACE	RF
CONSTRUCTION	
BODY	WAFER TYPE
	CATEGORY "B"
GEAR OPERATED	> = 8"
NOMINAL SIZE	6" - 48"
MATERIALS	
BODY	A351 Gr.CF3M
BODY SEAT	REINFORCED PTFE a)
DISC	SS316L
SHAFT	A276 Gr.316L
SHAFT PACKING	PTFE
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. FACE-TO-FACE DIMENSIONS SHALL BE PER API 609

MANDATORY STANDARDS:

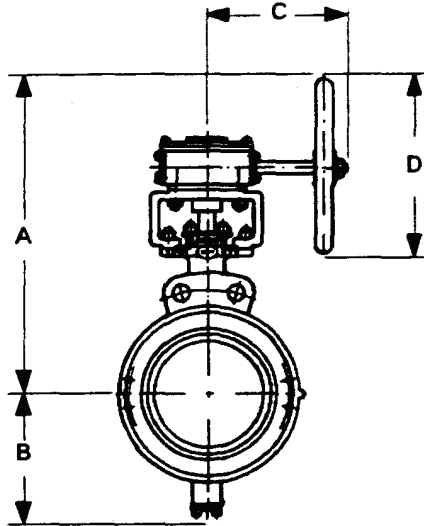
API 609, ANSI B16.34, ANSI B16.47, ANSI B16.5

NOTES:

- a) MANUFACTURER MAY RECOMMEND ALTERNATIVE SEAT MATERIAL AND SEAT RATING SUBJECT TO PURCHASER APPROVAL
- b) FLANGES > 24" ACC. TO ASME B16.47 SERIES B



BUTTERFLY VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	BUV 510
PRESSURE RATING CLASS	150
FACE	RF
CONSTRUCTION	
BODY	WAFER TYPE
	CATEGORY "B"
GEAR OPERATED	> = 8"
NOMINAL SIZE	6" - 48"
MATERIALS	
BODY	A 351 Gr. CF8
BODY SEAT	REINFORCED PTFE a)
DISC	STAINLESS TYPE 304
SHAFT	A 276 Gr. 304
SHAFT PACKING	PTFE
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. FACE-TO-FACE DIMENSIONS SHALL BE PER API 609

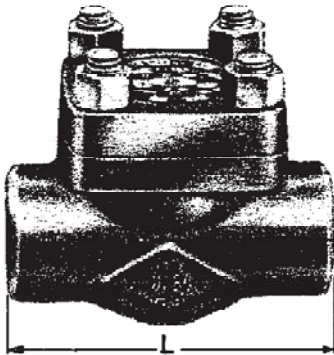
MANDATORY STANDARDS:

API 609, ANSI B16.34, ANSI B16.47, ANSI B16.5

NOTES:

- a) MANUFACTURER MAY RECOMMEND ALTERNATIVE SEAT MATERIAL AND SEAT RATING SUBJECT TO PURCHASER APPROVAL
- b) FLANGES > 24" ACC. TO ASME B16.47 SERIES B

CHECK VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	CHV 101	
PRESSURE RATING CLASS	800	
FACE	SW	
CONSTRUCTION		
BODY	FORGED	
BONNET TO BODY CONNECTION	BOLTED	
SEAT RING	RENEWABLE	
TYPE OF DISC	BALL	
NOMINAL SIZE	1/2" - 1 1/2"	
MATERIALS		
BODY	A 350 Gr. LF2	
BODY SEAT RING	AISI 304	
DISC	AISI 304	
DESIGN CONDITIONS		
PRESSURE RATING	API 602	
FLUID	Kg/cm ² g	°C

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. IF NOT OTHERWISE STATED THE VALVE SHALL BE FULL BORE

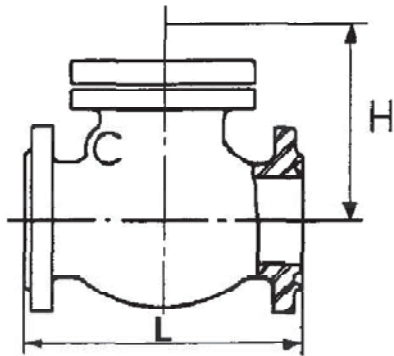
MANDATORY STANDARDS:

API 598, API 602, ANSI B16.11, ANSI B 16.34

NOTES:

- a) VALVE DESIGN SHALL GENERALLY COMPLY WITH API 602

CHECK VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	CHV 111	
PRESSURE RATING CLASS	300	
FACE	RF	
CONSTRUCTION		
BODY	CAST	
BONNET TO BODY CONNECTION	BOLTED	
SEAT RING	RENEWABLE	
TYPE OF DISC	SWING TYPE	
ACCESSORIES	NO	
BY-PASS	NO	
NOMINAL SIZE	2" - 24"	
MATERIALS		
BODY	A 352 Gr. LCB	
BODY SEAT RING	AISI 304	
DISC	AISI 304	
HINGE PIN	AISI 304	
DESIGN CONDITIONS		
PRESSURE RATING	ANSI B16.34	
FLUID	Kg/cm ² g	°C
AMMONIA GAS	30	50/33
AMMONIA LIQUID	40	50/33

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED

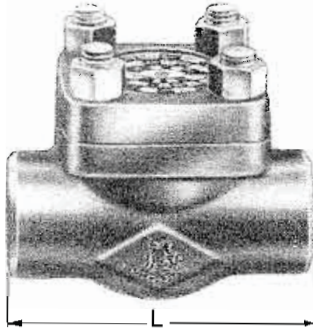
MANDATORY STANDARDS:

API 59B, API 600, ANSI B16.10, ANSI B16.34, ANSI B16.5, MSS-SP 45

NOTES:



CHECK VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	CHV 201S
PRESSURE RATING CLASS	800
FACE	SW IBR
CONSTRUCTION	
BODY	FORGED
BONNET TO BODY CONNECTION	BOLTED
SEAT RING	RENEWABLE
TYPE OF DISC	BALL
NOMINAL SIZE	1/2" - 1 1/2"
MATERIALS	
BODY	A 105
BODY SEAT RING	A 182 Gr. F6a STELLITED
DISC	13 Cr Stellite.
DESIGN CONDITIONS	
PRESSURE RATING	API 602

rev.1

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. IF NOT OTHERWISE STATED THE VALVE SHALL BE FULL BORE

MANDATORY STANDARDS:

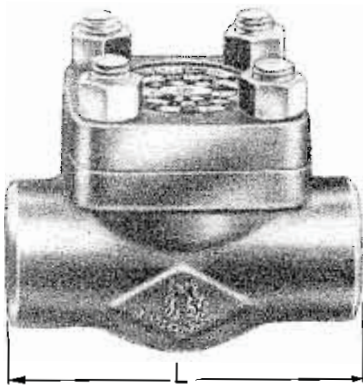
API 598, API 602, ANSI B16.11, ANSI B16.34

NOTES:

- a) VALVE DESIGN SHALL GENERALLY COMPLY WITH API 602
- b) VALVE TO BE SUPPLIED WITH IBR CERTIFICATION



CHECK VALVE



ITEM NO	CHV 201
PRESSURE RATING CLASS	800
FACE	SW
CONSTRUCTION	
BODY	FORGED
BONNET TO BODY CONNECTION	BOLTED
SEAT RING	RENEWABLE
TYPE OF DISC	BALL
NOMINAL SIZE	1/2" - 1 1/2"
MATERIALS	
BODY	A 105
BODY SEAT RING	A 182 Gr. F6a STELLITED
DISC	A 182 Gr. F6a
DESIGN CONDITIONS	
PRESSURE RATING	API 602

DESIGN (ILLUSTRATIVE ONLY)

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. IF NOT OTHERWISE STATED THE VALVE SHALL BE FULL BORE

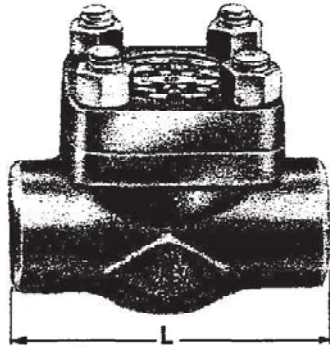
MANDATORY STANDARDS:

API 598, API 602, ANSI B16.11, ANSI B 16.34

NOTES:

- a) VALVE DESIGN SHALL GENERALLY COMPLY WITH API 602

CHECK VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	CHV 204S
PRESSURE RATING CLASS	1500
FACE	SW
CONSTRUCTION	
BODY	FORGED
BONNET TO BODY CONNECTION	BOLTED
SEAT RING	RENEWABLE
TYPE OF DISC	PISTON
NOMINAL SIZE	1/2" - 1"
MATERIALS	
BODY	A 105
BODY SEAT RING	A 182 Gr. F6a STELLITED
DISC	A 182 Gr. F6a STELLITED
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. IF NOT OTHERWISE STATED THE VALVE SHALL BE FULL BORE

MANDATORY STANDARDS:

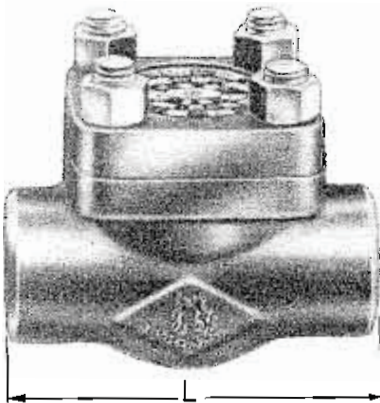
API 598, API 602, ANSI B16.11, ANSI B16.34

NOTES:

- a) VALVE DESIGN SHALL GENERALLY COMPLY WITH API 602
- b) VALVE TO BE SUPPLIED WITH IBR CERTIFICATION



CHECK VALVE



ITEM NO	CHV 207
PRESSURE RATING CLASS	800
FACE	THD
CONSTRUCTION	
BODY	FORGED
BONNET TO BODY CONNECTION	BOLTED
SEAT RING	RENEWABLE
TYPE OF DISC	BALL
NOMINAL SIZE	1/2" - 1 1/2"
MATERIALS	
BODY	A 105
BODY SEAT RING	A 182 Gr. F6a STELLITED
DISC	A 182 Gr. F6a
DESIGN CONDITIONS	
PRESSURE RATING	API 602

DESIGN (ILLUSTRATIVE ONLY)

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. IF NOT OTHERWISE STATED THE VALVE SHALL BE FULL BORE

MANDATORY STANDARDS:

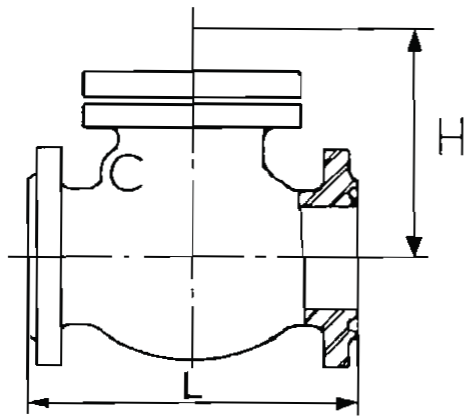
API 598, API 602, ANSI B16.11, ANSI B 16.34

NOTES:

- a) VALVE DESIGN SHALL GENERALLY COMPLY WITH API 602



CHECK VALVE



ITEM NO	CHV 210
PRESSURE RATING CLASS	150
FACE	RF
CONSTRUCTION	
BODY	CAST
BONNET TO BODY CONNECTION	BOLTED
SEAT RING	RENEWABLE
TYPE OF DISC	SWING TYPE
ACCESSORIES	NO
BY-PASS	NO
NOMINAL SIZE	2" - 24"
MATERIALS	
BODY	A 216 Gr. WCB
BODY SEAT RING	A 105 STELLITED
DISC	A 216 Gr. WCB 13Cr. FACED
HINGE PIN	13 Cr.
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

DESIGN (ILLUSTRATIVE ONLY)

GENERAL

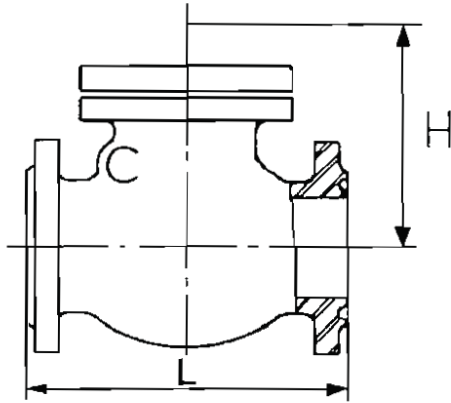
1. COPPER AND COPPER ALLOYS NOT PERMITTED

MANDATORY STANDARDS:

API 598, ANSI B16.10, ANSI B16.34, ANSI B16.5, MSS-SP 45



CHECK VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	CHV 210D
PRESSURE RATING CLASS	150
FACE	RF
CONSTRUCTION	
BODY	CAST
BONNET TO BODY CONNECTION	BOLTED
SEAT RING	RENEWABLE
TYPE OF DISC	SWING TYPE
ACCESSORIES	NO
BY-PASS	NO
NOMINAL SIZE	2" - 24"
MATERIALS	
BODY	A216 GR.WCB RUBBER LINED
BODY SEAT RING	A 105 STELLITED
DISC	A 216 Gr. WCB 13Cr. FACED
HINGE PIN	13 Cr.
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

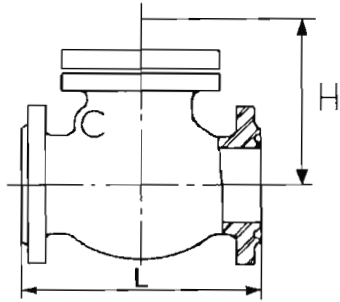
1. COPPER AND COPPER ALLOYS NOT PERMITTED

MANDATORY STANDARDS:

API 598, ANSI B16.10, ANSI B16.34, ANSI B16.5, MSS-SP 45



CHECK VALVE



ITEM NO	CHV 210S	
PRESSURE RATING CLASS	150	
FACE	RF IBR	
CONSTRUCTION		
BODY	CAST	
BONNET TO BODY CONNECTION	BOLTED	
SEAT RING	RENEWABLE	
TYPE OF DISC	SWING TYPE	
ACCESSORIES	NO	
BY-PASS	NO	
NOMINAL SIZE	2" - 24"	
MATERIALS		
BODY	A 216 Gr. WCB	
BODY SEAT RING	A105 STELLITED	
DISC	A 216 Gr. WCB 13Cr. FACED	
HINGE PIN	13 Cr.	
DESIGN CONDITIONS		
PRESSURE RATING	ANSI B16.34	
FLUID	Kg/cm2g	°C

rev.1

DESIGN (ILLUSTRATIVE ONLY)

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED

MANDATORY STANDARDS:

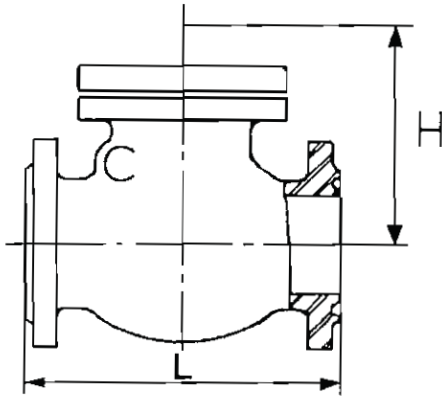
API 598, ANSI B16.10, ANSI B16.34, ANSI B16.5, MSS-SP 45

NOTES:

- a) VALVE TO BE SUPPLIED WITH IBR CERTIFICATION



CHECK VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	CHV 211
PRESSURE RATING CLASS	300
FACE	RF
CONSTRUCTION	
BODY	CAST
BONNET TO BODY CONNECTION	BOLTED
SEAT RING	RENEWABLE
TYPE OF DISC	SWING TYPE
ACCESSORIES	NO
BY-PASS	NO
NOMINAL SIZE	2" - 24"
MATERIALS	
BODY	A 216 Gr. WCB
BODY SEAT RING	A 105 STELLITED
DISC	A 216 Gr. WCB 13 Cr. FACED
HINGE PIN	13 Cr.
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

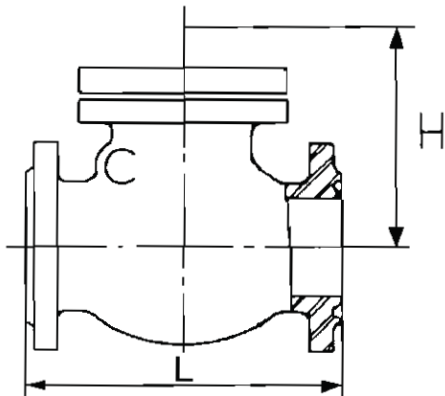
GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED

MANDATORY STANDARDS:

API 598, ANSI B16.10, ANSI B16.34, ANSI B16.5, MSS-SP 45

CHECK VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	CHV 212	
PRESSURE RATING CLASS	600	
FACE	RF	
CONSTRUCTION		
BODY	CAST	
BONNET TO BODY CONNECTION	BOLTED	
SEAT RING	RENEWABLE	
TYPE OF DISC	SWING TYPE	
ACCESSORIES	NO	
BY-PASS	NO	
NOMINAL SIZE	2" - 16"	
MATERIALS		
BODY	A 216 Gr. WCB	
BODY SEAT RING	A 105 STELLITED	
DISC	A 216 Gr. WCB STELLITED	
HINGE PIN	13 Cr.	
DESIGN CONDITIONS		
PRESSURE RATING	ANSI B16.34	
FLUID	Kg/cm ² g	°C

GENERAL

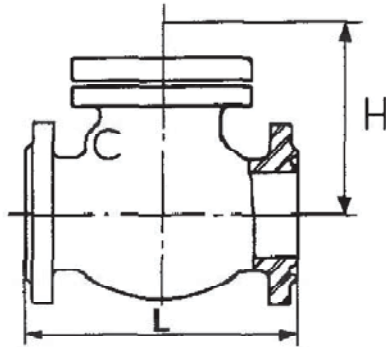
1. COPPER AND COPPER ALLOYS NOT PERMITTED

MANDATORY STANDARDS:

API 598, ANSI B16.10, ANSI B16.34, ANSI B16.5, MSS-SP 45

NOTES:

CHECK VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	CHV 212S
PRESSURE RATING CLASS	600
FACE	RF
CONSTRUCTION	
BODY	CAST
BONNET TO BODY CONNECTION	BOLTED
SEAT RING	RENEWABLE
TYPE OF DISC	SWING TYPE
ACCESSORIES	NO
BY-PASS	NO
NOMINAL SIZE	2" - 16"
MATERIALS	
BODY	A 216 Gr. WCB
BODY SEAT RING	A 182 Gr. F6a STELLITED
DISC	A 182 Gr. F6a STELLITED
HINGE PIN	13 Cr.
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED

MANDATORY STANDARDS:

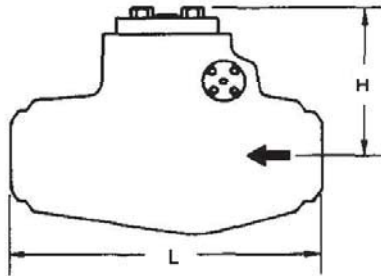
API 598, API 600, ANSI 816.10, ANSI B16.34, ANSI B16.5, MSS-SP 45

NOTES:

a) VALVE TO BE SUPPLIED WITH IBR CERTIFICATION



CHECK VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	CHV 216S
PRESSURE RATING CLASS	1500
FACE	BW
CONSTRUCTION	
BODY	CAST a)
BONNET TO BODY CONNECTION	PRESSURE SEAL
SEAT RING	WELDED
TYPE OF DISC	SWING TYPE
ACCESSORIES	NO
BY-PASS	NO
NOMINAL SIZE	1 1/2" - 24"
MATERIALS	
BODY	A 216 Gr. WCB
BODY SEAT RING	A 105 STELLITED
DISC	A 182 Gr. F6a STELLITED
HINGE PIN	13 Cr.
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED

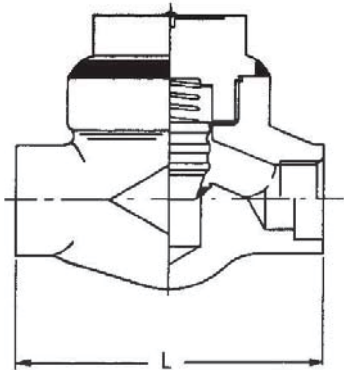
MANDATORY STANDARDS:

API 598, API 600, ANSI B16.10, ANSI B16.34, ANSI B16.5, MSS-SP 45

NOTES:

- a) END TO END DIMENSIONS SHALL BE SHORT PATTERN
- b) VALVE TO BE SUPPLIED WITH IBR CERTIFICATION

CHECK VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	CHV 305S
PRESSURE RATING CLASS	2500
FACE	SW
CONSTRUCTION	
BODY	FORGED
BONNET TO BODY CONNECTION	WELDED
SEAT RING	INTEGRAL
TYPE OF DISC	PISTON
NOMINAL SIZE	1/2" - 1 1/2"
MATERIALS	
BODY	A 182 Gr. F22
BODY SEAT RING	STELLITED
DISC	A 182 Gr. F6a STELLITED
DESIGN CDNDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. IF NOT OTHERWISE STATED THE VALVE SHALL BE FULL BORE

MANDATDRY STANDARDS:

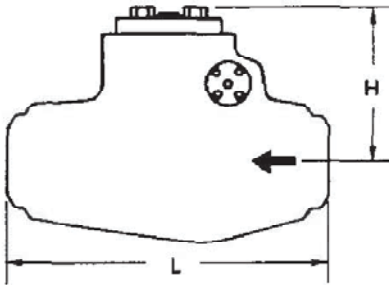
API 598, API 602, ANSI B16.11, ANSI B 16.34

NOTES:

- a) VALVE DESIGN SHALL GENERALLY COMPLY WITH API 602
- b) VALVE TO BE SUPPLIED WITH IBR CERTIFICATION



CHECK VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	CHV 326S
PRESSURE RATING CLASS	2600
FACE	BW
CONSTRUCTION	
BODY	CAST a)
BONNET TO BODY CONNECTION	PRESSURE SEAL
SEAT RING	WELDED
TYPE OF DISC	SWING TYPE
ACCESSORIES	NO
BY-PASS	NO
NOMINAL SIZE	2" - 18"
MATERIALS	
BODY	A 217 Gr. WC9
BODY SEAT RING	A 182 Gr. F22 STELLITED
DISC	A 182 Gr. F22 STELLITED
HINGE PIN	13 Cr.
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED

MANDATORY STANDARDS:

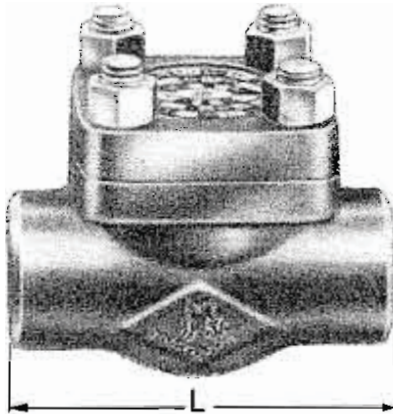
API 598, API 600, ANSI B16.10, ANSI B16.34, ANSI B16.5, MSS-SP 45

NOTES:

- a) END TO END DIMENSIONS SHALL BE SHORT PATTERN
- b) VALVE TO BE SUPPLIED WITH IBR CERTIFICATION



CHECK VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	CHV401
PRESSURE RATING CLASS	800
FACE	SW
CONSTRUCTION	
BODY	FORGED
BONNET TO BODY CONNECTION	BOLTED
SEAT RING	RENEWABLE
TYPE OF DISC	BALL
NOMINAL SIZE	1/2" - 1 1/2"
MATERIALS	
BODY	A182 Gr.F316L
BODY SEAT RING	SS316L
DISC	SS316L
DESIGN CONDITIONS	
PRESSURE RATING	API 602

rev.1
rev.1
rev.1

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. IF NOT OTHERWISE STATED THE VALVE SHALL BE FULL BORE

MANDATORY STANDARDS:

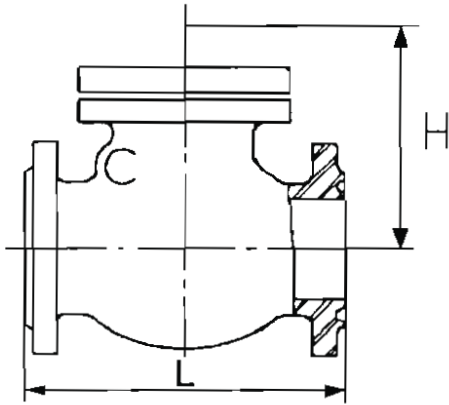
API 598, API 602, ANSI B16.11, ANSI B 16.34

NOTES:

- a) VALVE DESIGN SHALL GENERALLY COMPLY WITH API 602



CHECK VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	CHV410
PRESSURE RATING CLASS	150
FACE	RF
CONSTRUCTION	
BODY	CAST
BONNET TO BODY CONNECTION	BOLTED
SEAT RING	INTEGRAL
TYPE OF DISC	SWING TYPE
ACCESSORIES	NO
BY-PASS	NO
NOMINAL SIZE	2" - 24"
MATERIALS	
BODY	A351 Gr.CF3M
BODY SEAT RING	SS316L
DISC	SS316L
HINGE PIN	SS316L
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

rev.1
rev.1
rev.1
rev.1

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED

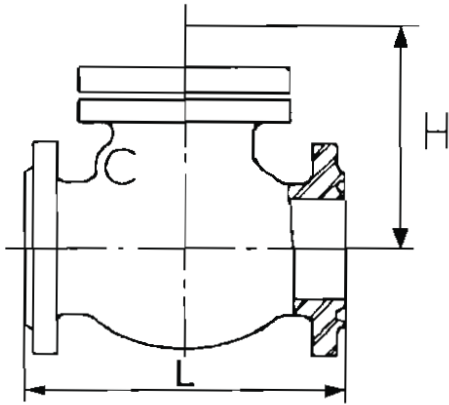
MANDATORY STANDARDS:

API 598, ANSI B16.10, ANSI B16.34, ANSI B16.5, MSS-SP 45

NOTES:



CHECK VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	CHV411
PRESSURE RATING CLASS	300
FACE	RF
CONSTRUCTION	
BODY	CAST
BONNET TO BODY CONNECTION	BOLTED
SEAT RING	INTEGRAL
TYPE OF DISC	SWING TYPE
ACCESSORIES	NO
BY-PASS	NO
NOMINAL SIZE	2" - 24"
MATERIALS	
BODY	A351 Gr.CF3M
BODY SEAT RING	SS316L
DISC	SS316L
HINGE PIN	SS316L
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

rev.1
rev.1
rev.1
rev.1

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED

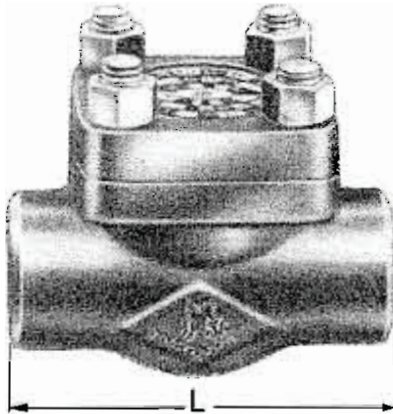
MANDATORY STANDARDS:

API 598, ANSI B16.10, ANSI B16.34, ANSI B16.5, MSS-SP 45

NOTES:



CHECK VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	CHV 501
PRESSURE RATING CLASS	800
FACE	SW
CONSTRUCTION	
BODY	FORGED
BONNET TO BODY CONNECTION	BOLTED
SEAT RING	RENEWABLE
TYPE OF DISC	BALL
NOMINAL SIZE	1/2" - 1 1/2"
MATERIALS	
BODY	A 182 Gr. F304
BODY SEAT RING	AISI 304
DISC	AISI 304
DESIGN CONDITIONS	
PRESSURE RATING	API 602

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. IF NOT OTHERWISE STATED THE VALVE SHALL BE FULL BORE

MANDATORY STANDARDS:

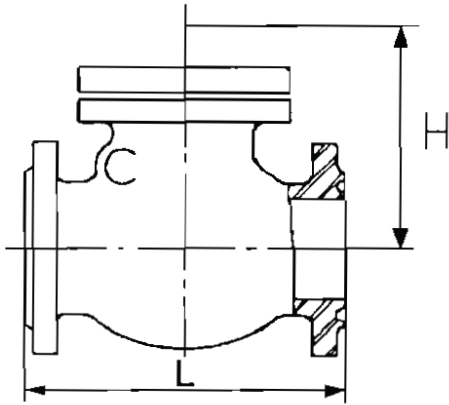
API 598, API 602, ANSI B16.11, ANSI B 16.34

NOTES:

- a) VALVE DESIGN SHALL GENERALLY COMPLY WITH API 602



CHECK VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	CHV 510
PRESSURE RATING CLASS	150
FACE	RF
CONSTRUCTION	
BODY	CAST
BONNET TO BODY CONNECTION	BOLTED
SEAT RING	INTEGRAL
TYPE OF DISC	SWING TYPE
ACCESSORIES	NO
BY-PASS	NO
NOMINAL SIZE	2" - 24"
MATERIALS	
BODY	A 351 Gr. CF8
BODY SEAT RING	A 182 Gr. F304 OR INTERGRAL
DISC	AISI 304
HINGE PIN	A 276 Gr. 304
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED

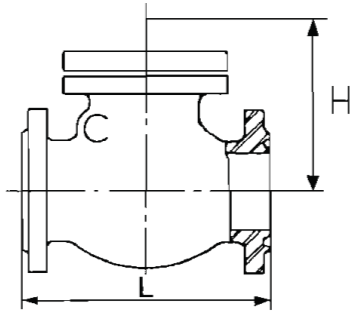
MANDATORY STANDARDS:

API 598, ANSI B16.10, ANSI B16.34, ANSI B16.5, MSS-SP 45

NOTES:



CHECK VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	CHV 511F
PRESSURE RATING CLASS	150
FACE	RF
CONSTRUCTION	
BODY	CAST
BONNET TO BODY CONNECTION	BOLTED
SEAT RING	INTERGRAL
TYPE OF DISC	SWING TYPE
ACCESSORIES	NO
BY-PASS	NO
NOMINAL SIZE	2" - 24"
MATERIALS	
BODY	A 351 Gr. CF8M
BODY SEAT RING	INTEGRAL
DISC	AISI 316
HINGE PIN	A 276 Gr. 316
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED

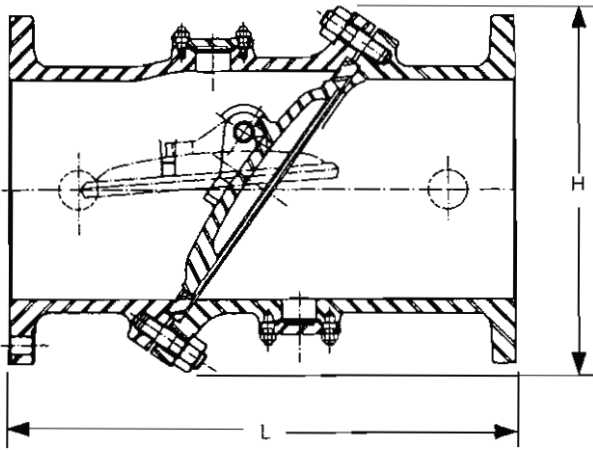
MANDATORY STANDARDS:

API 598, ANSI B16.10, ANSI B16.34, ANSI B16.5, MSS-SP 45

NOTES:



CHECK VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	CHV 520
PRESSURE RATING CLASS	150
FACE	RF
CONSTRUCTION	
BODY	CAST
BODY CONNECTION	BOLTED
SEAT RING	RENEWABLE
TYPE OF DISC	TILTING DISC
ACCESSORIES	NO
BY-PASS	NO
NOMINAL SIZE	26" - 36"
MATERIALS	
BODY	A 351 Gr. CF8
BODY SEAT RING	A 182 Gr. F304
DISC	A 351 Gr. CF8
HINGE PIN	A 276 Gr. 304
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED

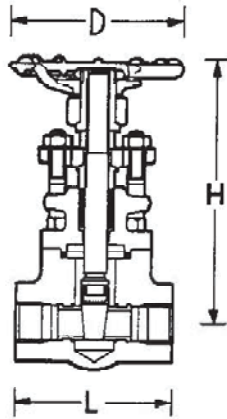
MANDATORY STANDARDS:

API 598, ANSI B16.10, ANSI B16.34, ASME B16.47 SERIES B

NOTES:

a) DIMENSIONS ACC. TO MANUFACTURERS STANDARD WITH REFERENCE TO ANSI B16.10

GATE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	GAV 101
PRESSURE RATING CLASS	800
FACE	SW
CONSTRUCTION	
BODY	FORGED
BONNET TO BODY CONNECTION	BOLTED
HANDWHEEL	NON-RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
GATE TYPE	WSS
GEAR OPERATED	NO
BY-PASS VALVE	ND
NOMINAL SIZE	1/2" - 1 1/2"
MATERIALS	
BODY	A 350 Gr. LF2
BODY SEAT RING	AISI 304
GATE	AISI 304
STEM	AISI 304
STEM PACKING	Graphoil
TRIM NUMBER	2

GATE SYMBOLS	TYPE OF SEAT	TYPE OF GATE	TYPE OF BLOCKAGE	DESIGN CONDITIONS		
				PRESSURE RATING	API 602	
				FLUID	Kg/cm ² g	°C
WSS	WEDGE	SINGLE	SOLID WEB			
WSF			FLEX. SOLID WEB			
WDF	PARALLEL	DOUBLE	SLIP ON OR SPLIT			
PDF			FLEXIBLE			

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE

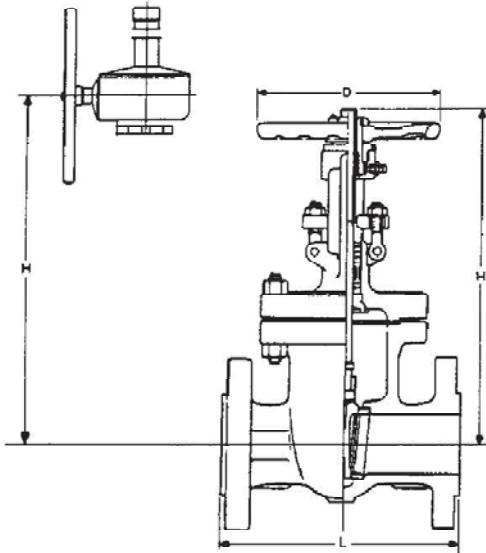
MANDATORY STANDARDS:

API 598, API 602, ANSI B16.11, ANSI B16.34

NOTES:

- a) LENGTH TO BE VERIFIED BY MANUFACTURER

GATE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	GAV 111
PRESSURE RATING CLASS	300
FACE	RF
CONSTRUCTION	
BODY	CAST
BONNET TO BODY CONNECTION	BOLTED
HANDWHEEL	NON-RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
GATE TYPE	WSF OR WDF
GEAR OPERATED	YES > = 10"
BY-PASS VALVE	NO
NOMINAL SIZE	1 1/2" - 24"
MATERIALS	
BODY	A 352 Gr. LCB
BODY SEAT RING	AISI 304
GATE	AISI 304
STEM	AISI 304
STEM PACKING	Graphoil
TRIM NUMBER	2

GATE SYMBOLS	TYPE OF SEAT	TYPE OF GATE	TYPE OF BLOCKADE	DESIGN CONDITIONS	
				PRESSURE RATING	ANSI B16.34
				FLUID	Kg/cm2g °C
WSS	WEDGE	SINGLE	SOLID WEB		
WSF			FLEX. SOLID WEB		
WDF	PARALLEL	DOUBLE	SLIP ON OR SPLIT		
PDF			FLEXIBLE		

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE
4. VALVES > = 10" AND > = 600" RATING SHALL HAVE BOSSES FOR BY-PASS CONNECTION ACC. TO API 600 AND MSS-SP 46, LOCATION E-F

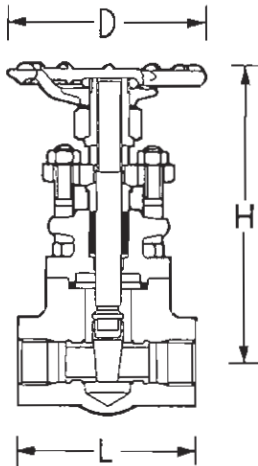
MANDATORY STANDARDS:

API 598, API 600, ANSI B16.10, ANSI B16.34, ANSI B16.5, MSS-SP 45

NOTES:



GATE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	GAV 201
PRESSURE RATING CLASS	800
FACE	SW
CONSTRUCTION	
BODY	FORGED
BONNET TO BODY CONNECTION	BOLTED
HANDWHEEL	NON-RISING
STEM (NO CASTING)	RISING
STEM AND YOKE TYPE	OS & Y
GATE TYPE	WSS
GEAR OPERATED	NO
BY-PASS VALVE	NO
NOMINAL SIZE	1/2" - 1 1/2"
MATERIALS	
BODY	A 105
BODY SEAT RING	A 182 Gr. F6a STELLITED
GATE	A 182 Gr. F6a
STEM	13 Cr.
STEM PACKING	GRAFOIL/GRAPHITE
TRIM NUMBER	8

GATE SYMBOLS	TYPE OF SEAT	TYPE OF GATE	TYPE OF BLOCKADE
WSS	WEDGE	SINGLE	SOLID WEB
WSF			FLEX. SOLID WEB
WDF	PARALLEL	DOUBLE	SLIP ON OR SPLIT
PDF			FLEXIBLE

DESIGN CONDITIONS	
PRESSURE RATING	API 602

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE

MANDATORY STANDARDS:

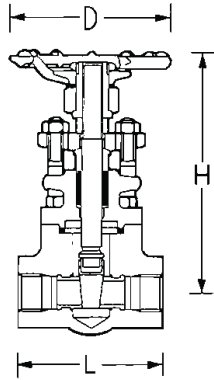
API 598, API 602, ANSI B16.11, ANSI B16.34

NOTES:

- a) LENGTH TO BE VERIFIED BY MANUFACTURER



GATE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	GAV 201S
PRESSURE RATING CLASS	800
FACE	SW IBR
CONSTRUCTION	
BODY	FORGED
BONNET TO BODY CONNECTION	BOLTED
HANDWHEEL	NON-RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
GATE TYPE	WSS
GEAR OPERATED	NO
BY-PASS VALVE	NO
NOMINAL SIZE	1/2" - 1 1/2"
MATERIALS	
BODY	A 105
BODY SEAT RING	A 182 Gr. F6a STELLITED
GATE	A 182 Gr. F6a
STEM	13 Cr.
STEM PACKING	GRAPHITE
TRIM NUMBER	8

rev.1

GATE SYMBOLS	TYPE OF SEAT	TYPE OF GATE	TYPE OF BLOCKADE	DESIGN CONDITIONS	
				PRESSURE RATING	API 602
WSS	WEDGE	SINGLE	SOLID WEB		
WSF			FLEX. SOLID WEB		
WDF	PARALLEL	DOUBLE	SLIP ON OR SPLIT		
PDF			FLEXIBLE		

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE

MANDATORY STANDARDS:

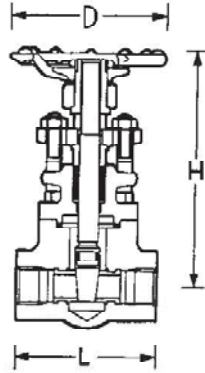
API 598, API 602, ANSI B16.11, ANSI B16.34

NOTES:

- a) LENGTH TO BE VERIFIED BY MANUFACTURER
- b) VALVE TO BE SUPPLIED WITH IBR CERTIFICATION



GATE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	GAV 202S
PRESSURE RATING CLASS	800
FACE	SW
CONSTRUCTION	
BODY	FORGED
BONNET TO BODY CONNECTION	BOLTED
HANDWHEEL	NON-RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
GATE TYPE	WSS
GEAR OPERATED	NO
BY-PASS VALVE	NO
NOMINAL SIZE	1/2" - 1 1/2"
MATERIALS	
BODY	A 105
BODY SEAT RING	A 182 Gr. F6a STELLITED
GATE	A 182 Gr. F6a STELLITED
STEM	13 Cr.
STEM PACKING	GRAPHOIL
TRIM NUMBER	5

GATE SYMBOLS	TYPE OF SEAT	TYPE OF GATE	TYPE OF BLOCKADE
WSS	WEDGE	SINGLE	SOLID WEB
WSF			FLEX. SOLID WEB
WDF	PARALLEL	DOUBLE	SLIP ON OR SPLIT
PDF		FLEXIBLE	

DESIGN CONDITIONS	
PRESSURE RATING	API 602

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE

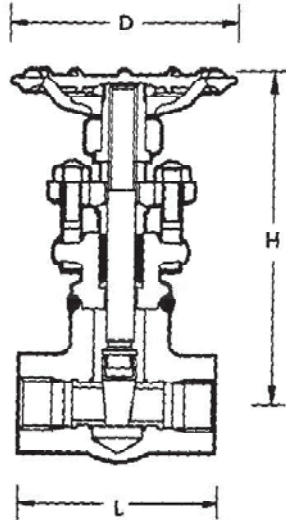
MANDATORY STANDARDS:

API 598, API 602, ANSI B16.11, ANSI B16.34

NOTES:

- a) LENGTH TO BE VERIFIED BY MANUFACTURER
- b) VALVE TO BE SUPPLIED WITH IBR CERTIFICATION

GATE VALVE



DESIGN (ILLUSTRATIVE ONLY)

GATE SYMBOLS	TYPE OF SEAT	TYPE OF GATE	TYPE OF BLOCKADE	DESIGN CONDITIONS	
				PRESSURE RATING	ANSI B16.34
WSS	WEDGE	SINGLE	SOLID WEB		
WSF			FLEX. SOLID WEB		
WDF	PARALLEL	DOUBLE	SLIP ON OR SPLIT		
PDF			FLEXIBLE		

ITEM NO	GAV 204S
PRESSURE RATING CLASS	1500
FACE	SW
CONSTRUCTION	
BODY	FORGED
BONNET TO BODY CONNECTION	WELDED
HANDWHEEL	NON-RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
GATE TYPE	WSS
GEAR OPERATED	NO
BY-PASS VALVE	NO
NOMINAL SIZE	1/2" - 1"
MATERIALS	
BODY	A 105
BODY SEAT RING	A 182 Gr. F6a STELLITED
GATE	A 182 Gr. F6a STELLITED
STEM	13 Cr.
STEM PACKING	GRAPHOIL
TRIM NUMBER	8

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE

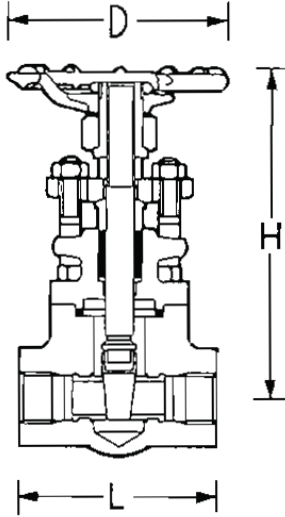
MANDATORY STANDARDS:

API 598, API 602, ANSI B16.11, ANSI B16.34

NOTES:

- a) LENGTH TO BE VERIFIED BY MANUFACTURER
- b) VALVE TO BE SUPPLIED WITH ISR CERTIFICATION

GATE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	GAV 207
PRESSURE RATING CLASS	800
FACE	THD
CONSTRUCTION	
BODY	FORGED
BONNET TO BODY CONNECTION	BOLTED
HANDWHEEL	NON-RISING
STEM (NO CASTING)	RISING
STEM AND YOKE TYPE	OS & Y
GATE TYPE	WSS
GEAR OPERATED	NO
BY-PASS VALVE	NO
NOMINAL SIZE	1/2" - 1 1/2"
MATERIALS	
BODY	A 105
BODY SEAT RING	A 182 Gr. F6a STELLITED
GATE	A 182 Gr. F6a
STEM	13 Cr.
STEM PACKING	GRAFOIL /GRAPHITE
TRIM NUMBER	8

GATE SYMBOLS	TYPE OF SEAT	TYPE OF GATE	TYPE OF BLOCKADE
WSS	WEDGE	SINGLE	SOLID WEB
WSF			FLEX. SOLID WEB
WDF	PARALLEL	DOUBLE	SLIP ON OR SPLIT
PDF			FLEXIBLE

DESIGN CONDITIONS	
PRESSURE RATING	API 602

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE

MANDATORY STANDARDS:

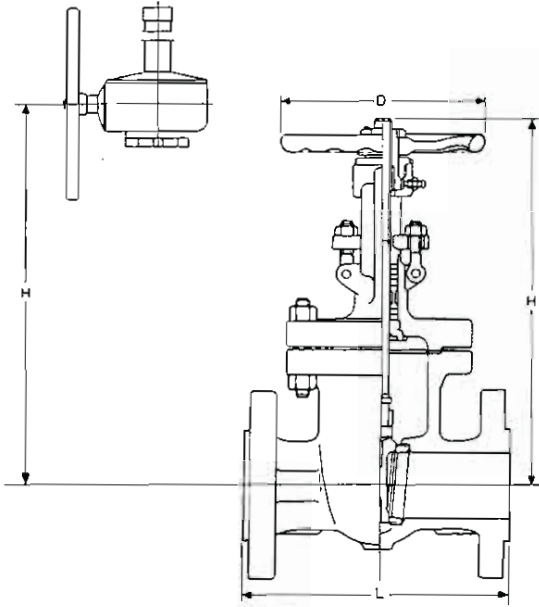
API 598, API 602, ANSI B16.11, ANSI B16.34

NOTES:

- a) LENGTH TO BE VERIFIED BY MANUFACTURER



GATE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	GAV 210
PRESSURE RATING CLASS	150
FACE	RF
CONSTRUCTION	
BODY	CAST
BONNET TO BODY CONNECTION	BOLTED
HANDWHEEL	NON-RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
GATE TYPE	WSF OR WDF
GEAR OPERATED	YES $\geq 14"$
BY-PASS VALVE	NO
NOMINAL SIZE	2" - 48"
MATERIALS	
BODY	A 216 Gr. WCB
BODY SEAT RING	A 105 STELLITED
GATE	A 216 Gr. WCB 13 Cr. FACED
STEM (NO CASTING)	13 Cr.
STEM PACKING	GRAFOIL /GRAPHITE
TRIM NUMBER	8

GATE SYMBOLS	TYPE OF SEAT	TYPE OF GATE	TYPE OF BLOCKADE
WSS	WEDGE	SINGLE	SOLID WEB
WSF			FLEX. SOLID WEB
WDF	PARALLEL	DOUBLE	SLIP ON OR SPLIT
PDF			FLEXIBLE

DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE
4. VALVES $\geq 10"$ AND $\geq 600"$ RATING SHALL HAVE BOSSES FOR BY-PASS CONNECTION ACC. TO API 600 AND MSS-SP 45, LOCATION E-F

MANDATORY STANDARDS:

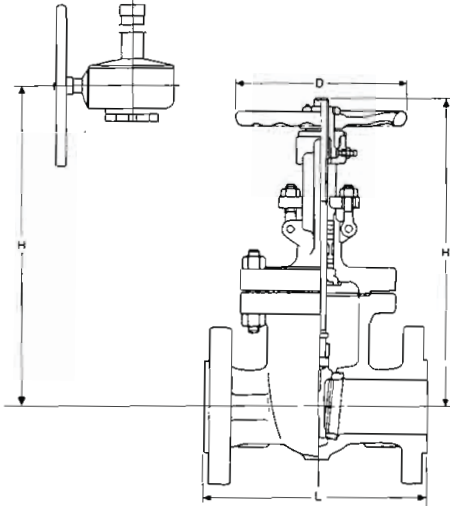
API 598, API 600, ANSI B16.10, ANSI B16.34, ANSI B16.5, MSS-SP 45, ASME B16.47

NOTES:

a) FLANGES $> 24"$ ACC. TO ASME B16.47 SERIES B



GATE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	GAV 210S
PRESSURE RATING CLASS	150
FACE	RF IBR
CONSTRUCTION	
BODY	CAST
BONNET TO BODY CONNECTION	BOLTED
HANDWHEEL	NON-RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
GATE TYPE	WSF OR WDF c)
GEAR OPERATED	YES > = 14"
BY-PASS VALVE	NO
NOMINAL SIZE	1 1/2" - 48"
MATERIALS	
BODY	A 216 Gr. WCB
BODY SEAT RING	A 105 STELLITED
GATE	A 216 Gr. WCB 13 Cr. FACED
STEM	13 Cr.
STEM PACKING	GRAPHITE
TRIM NUMBER	8

rev.1

GATE SYMBOLS	TYPE OF SEAT	TYPE OF GATE	TYPE OF BLOCKADE
WSS	WEDGE	SINGLE	SOLID WEB
WSF			FLEX. SOLID WEB
WDF	PARALLEL	DOUBLE	SLIP ON OR SPLIT
PDF			FLEXIBLE

DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE
4. VALVES > = 10" AND > = 600" RATING SHALL HAVE BOSSES FOR BY-PASS CONNECTION ACC. TO API 600 AND MSS-SP 45, LOCATION E-F

MANDATORY STANDARDS:

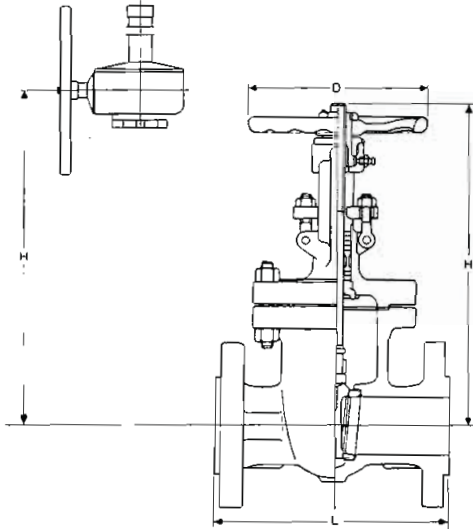
API 598, API 600, ANSI B16.10, ANSI B16.34, ANSI B16.5, MSS-SP 45, ASME B16.47

NOTES:

- a) FLANGES > 24" ACC. TO ASME B16.47 SERIES B
- b) VALVE TO BE SUPPLIED WITH IBR CERTIFICATION
- c) WSF IS ACCEPTABLE FOR SIZES < = 12" ONLY



GATE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	GAV 211
PRESSURE RATING CLASS	300
FACE	RF
CONSTRUCTION	
BODY	CAST
BONNET TO BODY CONNECTION	BOLTED
HANDWHEEL	NON-RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
GATE TYPE	WSF OR WDF a)
GEAR OPERATED	YES $\geq 10"$
BY-PASS VALVE	NO
NOMINAL SIZE	2" - 24"
MATERIALS	
BODY	A 216 Gr. WCB
BODY SEAT RING	A 105 STELLITED
GATE	A 216 Gr. WCB 13 Cr. FACED
STEM (NO CASTING)	13 Cr.
STEM PACKING	GRAFOIL /GRAPHITE
TRIM NUMBER	8

GATE SYMBOLS	TYPE OF SEAT	TYPE OF GATE	TYPE OF BLOCKADE	DESIGN CONDITIONS	
				PRESSURE RATING	ANSI B16.34
WSS	WEDGE	SINGLE	SOLID WEB		
WSF			FLEX. SOLID WEB		
WDF		DOUBLE	SLIP ON OR SPLIT		
PDF	PARALLEL		FLEXIBLE		

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE
4. VALVES $\geq 10"$ AND $\geq 600"$ RATING SHALL HAVE BOSSES FOR BY-PASS CONNECTION ACC. TO API 600 AND MSS-SP 45, LOCATION E-F

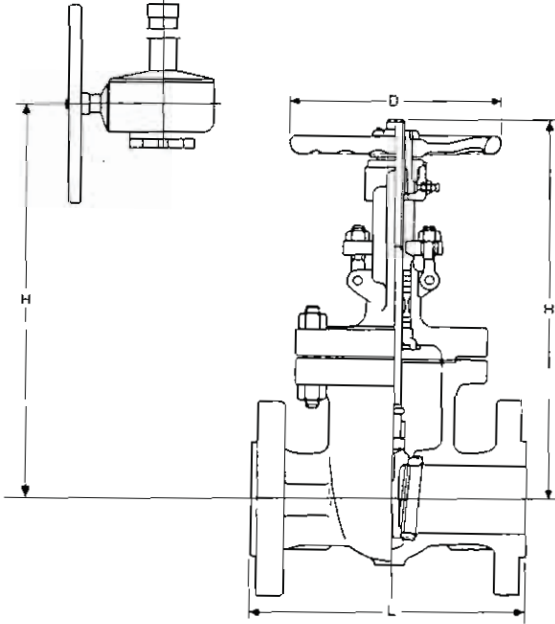
MANDATORY STANDARDS:

API 598, API 600, ANSI B16.10, ANSI B16.34, ANSI B16.5, MSS-SP 45

NOTES:

a) WSF IS ACCEPTABLE FOR SIZES $\leq 12"$ ONLY

GATE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	GAV 212
PRESSURE RATING CLASS	600
FACE	RF
CONSTRUCTION	
BODY	CAST
BONNET TO BODY CONNECTION	BOLTED
HANDWHEEL	NON-RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
GATE TYPE	WSF OR WDF a)
GEAR OPERATED	YES > = 8"
BY-PASS VALVE	NO, SEE GEN. NOTE 4
NOMINAL SIZE	1 1/2" - 24"
MATERIALS	
BODY	A 216 Gr. WCB
BODY SEAT RING	A 105 STELLITED
GATE	A 216 Gr. WCB
STEM	13 Cr.
STEM PACKING	GRAFOIL
TRIM NUMBER	8

GATE SYMBOLS	TYPE OF SEAT	TYPE OF GATE	TYPE OF BLOCKADE
WSS	WEDGE	SINGLE	SOLID WEB
WSF			FLEX. SOLID WEB
WDF		DOUBLE	SLIP ON OR SPLIT
PDF	PARALLEL		FLEXIBLE

DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE
4. VALVES > = 10" AND > = 600" RATING SHALL HAVE BOSSES FOR BY-PASS CONNECTION ACC. TO API 600 AND MSS-SP 45, LOCATION E-F

MANDATORY STANDARDS:

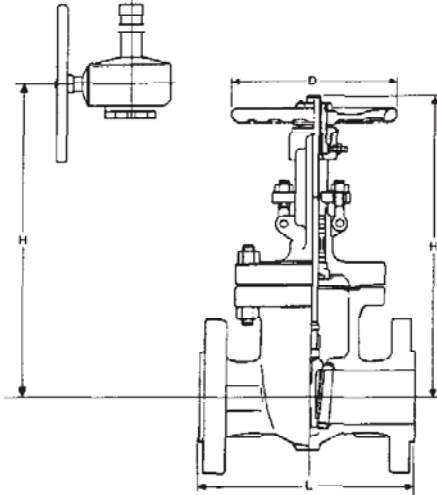
API 598, API 600, ANSI B16.10, ANSI B16.34, ANSI B16.5, MSS-SP 45

NOTES:

a) WSF IS ACCEPYABLE FOR SIZES < = 6" ONLY



GATE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	GAV 212S
PRESSURE RATING CLASS	600
FACE	RF
CONSTRUCTION	
BODY	CAST
BONNET TO BODY CONNECTION	BOLTED
HANDWHEEL	NON-RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
GATE TYPE	WSF OR WDF
GEAR OPERATED	YES > = 8"
BY-PASS VALVE	NO, SEE GEN. NOTE 4
NOMINAL SIZE	1 1/2" - 24"
MATERIALS	
BODY	A 216 Gr. WCB
BODY SEAT RING	A 182 Gr. F6a STELLITED
GATE	A 182 Gr. F6a STELLITED
STEM	13 Cr.
STEM PACKING	GRAPHOIL
TRIM NUMBER	5

GATE SYMBOLS	TYPE OF SEAT	TYPE OF GATE	TYPE OF BLOCKADE
WSS	WEDGE	SINGLE	SOLID WEB
WSF			FLEX. SOLID WEB
WDF	PARALLEL	DOUBLE	SLIP ON OR SPLIT
PDF			FLEXIBLE

DESIGN CONDITIONS	
PRESSURE RATING	ANSI 816.34

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE
4. VALVES > = 10" AND > = 600" RATING SHALL HAVE BOSSES FOR BY-PASS CONNECTION ACC. TO API 600 AND MSS SP 46, LOCATION E F

MANDATORY STANDARDS:

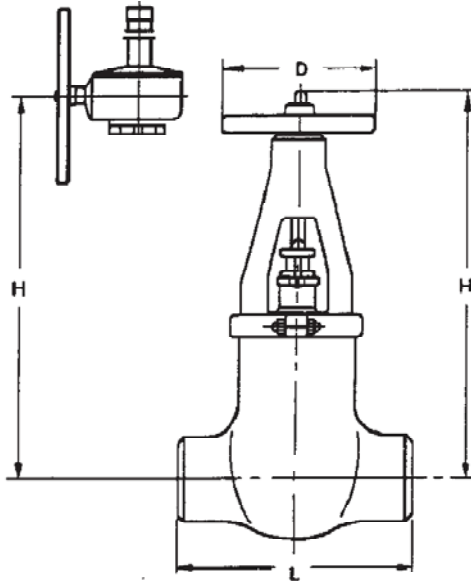
API 598, API 600, ANSI B16.10, ANSI B16.34, ANSI B16.5, MSS-SP 45

NOTES:

- a) VALVE TO BE SUPPLIED WITH IBR CERTIFICATION



GATE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	GAV 216S
PRESSURE RATING CLASS	1800
FACE	BW
CONSTRUCTION	
BODY	CAST OR FORGED a)
BONNET TO BODY CONNECTION	PRESSURE SEAL
HANDWHEEL	NON-RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
GATE TYPE	WSF OR WDF
GEAR OPERATED	YES > = 8"
BY-PASS VALVE	NO, SEE GEN. NOTE 4
NOMINAL SIZE	1 1/2" - 24"
MATERIALS	
BODY	A 216 Gr. WCB
BODY SEAT RING	A 182 Gr. F6a STELLITED
GATE	A 182 Gr. F6a STELLITED
STEM	13 Cr.
STEM PACKING	GRAPHOIL
TRIM NUMBER	8

GATE SYMBOLS	TYPE OF SEAT	TYPE OF GATE	TYPE OF BLOCKADE
WSS	WEDGE	SINGLE	SOLID WEB
WSF			FLEX. SOLID WEB
WOF			SLIP ON OR SPLIT
PDF	PARALLEL	DOUBLE	FLEXIBLE

DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE
4. VALVES > = 10" AND > = 600" RATING SHALL HAVE BOSSES FOR BY-PASS CONNECTION ACC. TO API 600 AND MSS-SP 45, LOCATION E-F

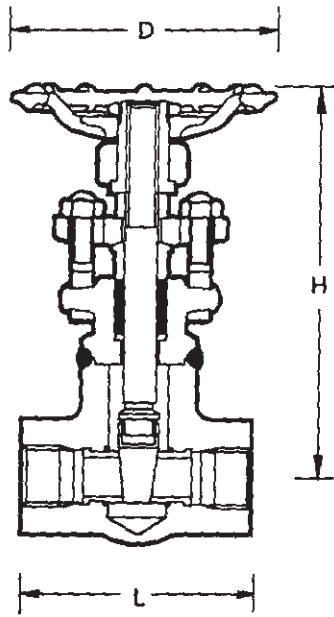
MANDATORY STANDARDS:

API 598, API 600, ANSI B16.10, ANSI B16.34, ANSI B16.5, MSS-SP 45

NOTES:

- a) END TO END DIMENSION SHALL BE SHORT PATTERN
- b) VALVE TO BE SUPPLIED WITH IBR CERTIFICATION
- c) VALVES > = 6" SHALL HAVE YOKE BUSHING THRUST BEARINGS

GATE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	GAV 305S
PRESSURE RATING CLASS	2500
FACE	SW
CONSTRUCTION	
BODY	FORGED
BONNET TO BODY CONNECTION	WELDED
HANDWHEEL	NON-RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
GATE TYPE	WSS
GEAR OPERATED	NO
BY-PASS VALVE	NO
NOMINAL SIZE	1/2" - 1 1/2"
MATERIALS	
BODY	A 182 Gr. F22
BODY SEAT RING	A 182 Gr. F6a STELLITED
GATE	A 182 Gr. F6a STELLITED
STEM	13 Cr.
STEM PACKING	GRAPHOIL
TRIM NUMBER	5

GATE SYMBOLS	TYPE OF SEAT	TYPE OF GATE	TYPE OF BLOCKADE
WSS	WEDGE	SINGLE	SOLID WEB
WSF			FLEX. SOLID WEB
WDF		DOUBLE	SLIP ON OR SPLIT
PDF	PARALLEL		FLEXIBLE

DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE

MANDATORY STANDARDS:

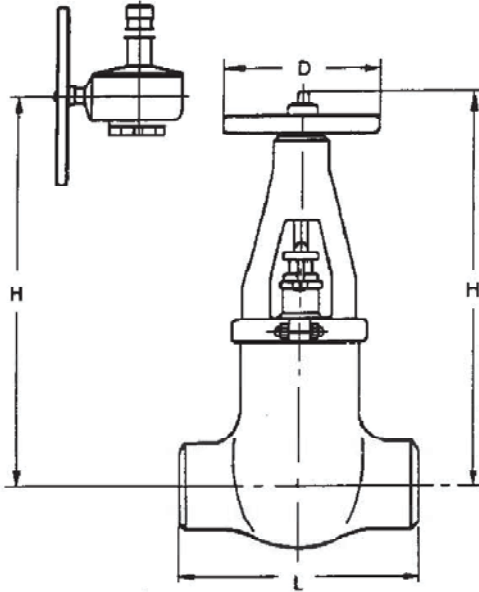
API 598, API 602, ANSI B16.11, ANSI B16.34

NOTES:

- a) LENGTH TO BE VERIFIED BY MANUFACTURER
- b) VALVE TO BE SUPPLIED WITH IBR CERTIFICATION



GATE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO.	GAV 326S
PRESSURE RATING CLASS	2500
FACE	BW
CONSTRUCTION	
BODY	CAST OR FORGED a)
BONNET TO BODY CONNECTION	PRESSURE SEAL
HANDWHEEL	NON-RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
GATE TYPE	WSF OR WDF
GEAR OPERATED	YES > = 8"
BY-PASS VALVE	ND, SEE GEN. NOTE 4
NOMINAL SIZE	1 1/2" - 16"
MATERIALS	
BODY	A 217 Gr. WC9
BODY SEAT RING	A 182 Gr. F6a STELLITED
GATE	A 182 Gr. F6a STELLITED
STEM	13 Cr.
STEM PACKING	GRAPHOIL
TRIM NUMBER	5

GATE SYMBOLS	TYPE OF SEAT	TYPE OF GATE	TYPE OF BLDCKADE
WSS	WEDGE	SINGLE	SOLIO WEB
WSF			FLEX..SOLID WEB
WDF	PARALLEL	DOUBLE	SLIP ON OR SPLIT
PDF			FLEXIBLE

DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE
4. VALVES > = 10" AND > = 600" RATING SHALL HAVE BOSSES FOR BY-PASS CONNECTION ACC. TO API 600 AND MSS-SP 45, LOCATION E-F

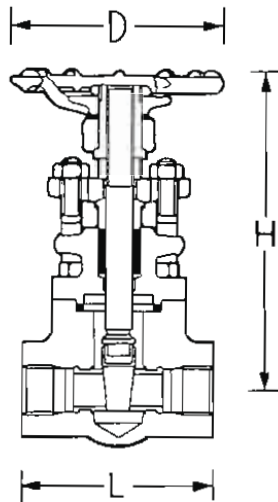
MANDATORY STANDARDS:

API 598, API 600, ANSI B16.10, ANSI B16.34, ANSI B16.5, MSS-SP 45

NOTES:

- a) END TO END DIMENSION SHALL BE SHORT PATTERN
- b) VALVE TO BE SUPPLIED WITH IBR CERTIFICATION
- c) VALVES > = 6" SHALL HAVE YOKE BUSHING THRUST BEARINGS

GATE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	GAV 401
PRESSURE RATING CLASS	800
FACE	SW
CONSTRUCTION	
BODY	FORGED
BONNET TO BODY CONNECTION	BOLTED
HANDWHEEL	NON-RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
GATE TYPE	WSS
GEAR OPERATED	NO
BY-PASS VALVE	NO
NOMINAL SIZE	1/2" - 1 1/2"
MATERIALS	
BODY	A182 GR.F316L
BODY SEAT RING	A182 GR.F316L
GATE	A182 GR.F316L
STEM	A182 GR.F316L
STEM PACKING	GRAFOIL /GRAPHITE
TRIM NUMBER	2

GATE SYMBOLS	TYPE OF SEAT	TYPE OF GATE	TYPE OF BLOCKADE
WSS	WEDGE	SINGLE	SOLID WEB
WSF			FLEX. SOLID WEB
WDF	PARALLEL	DOUBLE	SLIP ON OR SPLIT
PDF			FLEXIBLE

DESIGN CONDITIONS	
PRESSURE RATING	API 602

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE

MANDATORY STANDARDS:

API 598, API 602, ANSI B16.11, ANSI B16.34

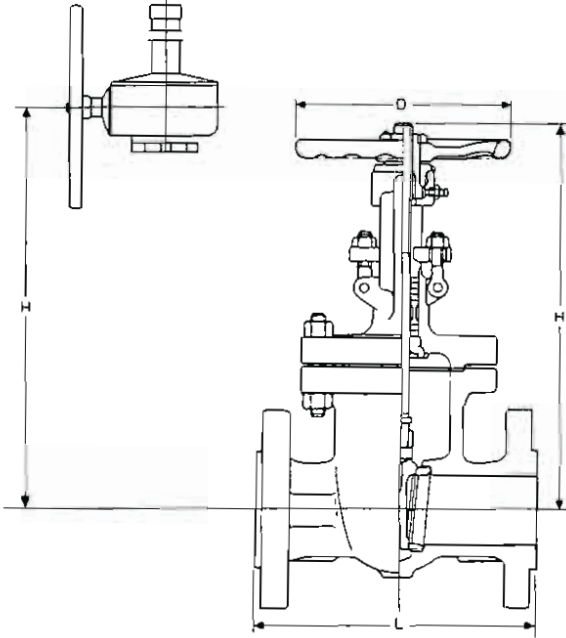
NOTES:

- a) LENGTH TO BE VERIFIED BY MANUFACTURER

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GATE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	GAV 410
PRESSURE RATING CLASS	150
FACE	RF
CONSTRUCTION	
BODY	CAST
BONNET TO BODY CONNECTION	BOLTED
HANDWHEEL	NON-RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
GATE TYPE	WSF OR WDF
GEAR OPERATED	YES $\geq 14"$
BY-PASS VALVE	NO
NOMINAL SIZE	2" - 24"
MATERIALS	
BODY	A351 Gr.CF3M
BODY SEAT RING	A182 Gr.F316L
GATE	SS 316L
STEM	SS 316L
STEM PACKING	GRAFOIL /GRAPHITE
TRIM NUMBER	2

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rev.1
rev.1

GATE SYMBOLS	TYPE OF SEAT	TYPE OF GATE	TYPE OF BLOCKADE
WSS	WEDGE	SINGLE	SOLID WEB
WSF			FLEX. SOLID WEB
WDF	PARALLEL	DOUBLE	SLIP ON OR SPLIT
PDF			FLEXIBLE

DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE
4. VALVES $\geq 10"$ AND $\geq 600"$ RATING SHALL HAVE BOSSES FOR BY-PASS CONNECTION ACC. TO API 600 AND MSS-SP 45, LOCATION E-F

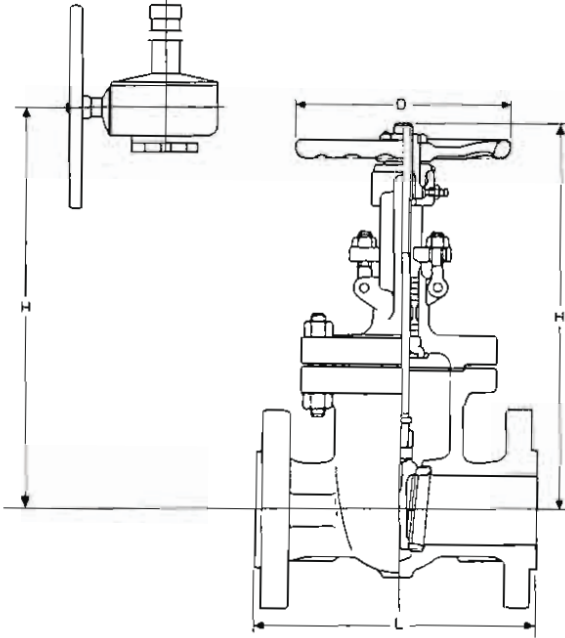
MANDATORY STANDARDS:

API 598, API 600, ANSI B16.10, ANSI B16.34, ANSI B16.5, MSS-SP 45

NOTES:



GATE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	GAV 411
PRESSURE RATING CLASS	300
FACE	RF
CONSTRUCTION	
BODY	CAST
BONNET TO BODY CONNECTION	BOLTED
HANDWHEEL	NON-RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
GATE TYPE	WSF OR WDF
GEAR OPERATED	YES $\geq 14"$
BY-PASS VALVE	NO
NOMINAL SIZE	2" - 24"
MATERIALS	
BODY	A351 Gr.CF3M
BODY SEAT RING	A182 Gr.F316L
GATE	SS 316L
STEM	SS 316L
STEM PACKING	GRAFOIL /GRAPHITE
TRIM NUMBER	2

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rev.1
rev.1
rev.1

GATE SYMBOLS	TYPE OF SEAT	TYPE OF GATE	TYPE OF BLOCKADE
WSS	WEDGE	SINGLE	SOLID WEB
WSF			FLEX. SOLID WEB
WDF	PARALLEL	DOUBLE	SLIP ON OR SPLIT
PDF			FLEXIBLE

DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

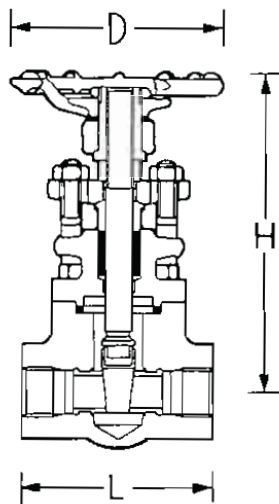
1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE
4. VALVES $\geq 10"$ AND $\geq 600"$ RATING SHALL HAVE BOSSES FOR BY-PASS CONNECTION ACC. TO API 600 AND MSS-SP 45, LOCATION E-F

MANDATORY STANDARDS:

API 598, API 600, ANSI B16.10, ANSI B16.34, ANSI B16.5, MSS-SP 45

NOTES:

GATE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	GAV 501
PRESSURE RATING CLASS	800
FACE	SW
CONSTRUCTION	
BODY	FORGED
BONNET TO BODY CONNECTION	BOLTED
HANDWHEEL	NON-RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
GATE TYPE	WSS
GEAR OPERATED	NO
BY-PASS VALVE	NO
NOMINAL SIZE	1/2" - 1 1/2"
MATERIALS	
BODY	A 182 Gr. F304
BODY SEAT RING	A 182 Gr. F304
GATE	A 182 Gr. F304
STEM	A 276 Gr. 304
STEM PACKING	GRAFOIL / GRAPHITE
TRIM NUMBER	2

GATE SYMBOLS	TYPE OF SEAT	TYPE OF GATE	TYPE OF BLOCKADE
WSS	WEDGE	SINGLE	SOLID WEB
WSF			FLEX. SOLID WEB
WDF	PARALLEL	DOUBLE	SLIP ON OR SPLIT
PDF			FLEXIBLE

DESIGN CONDITIONS	
PRESSURE RATING	API 602

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE

MANDATORY STANDARDS:

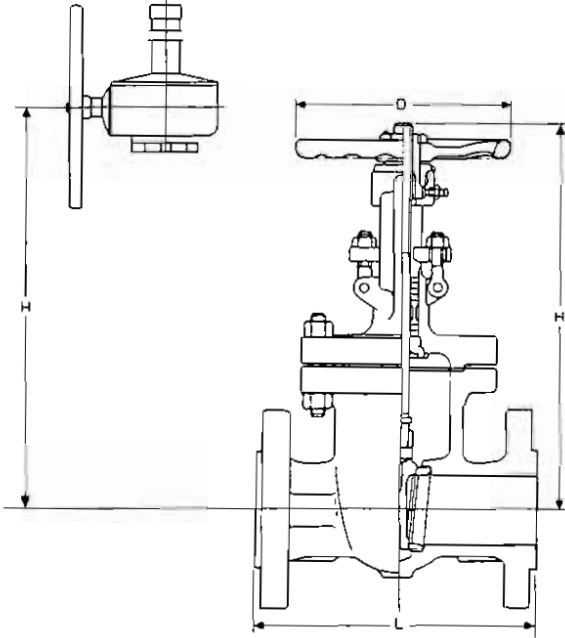
API 598, API 602, ANSI B16.11, ANSI B16.34

NOTES:

- a) LENGTH TO BE VERIFIED BY MANUFACTURER



GATE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	GAV 510
PRESSURE RATING CLASS	150
FACE	RF
CONSTRUCTION	
BODY	CAST
BONNET TO BODY CONNECTION	BOLTED
HANDWHEEL	NON-RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
GATE TYPE	WSF OR WDF
GEAR OPERATED	YES $\geq 14"$
BY-PASS VALVE	NO
NOMINAL SIZE	2" - 24"
MATERIALS	
BODY	A 351 Gr. CF8
BODY SEAT RING	A 182 Gr. F304
GATE	AISI 304
STEM	A 276 Gr. 304
STEM PACKING	GRAFOIL /GRAPHITE
TRIM NUMBER	2

GATE SYMBOLS	TYPE OF SEAT	TYPE OF GATE	TYPE OF BLOCKADE
WSS	WEDGE	SINGLE	SOLID WEB
WSF			FLEX. SOLID WEB
WDF	PARALLEL	DOUBLE	SLIP ON OR SPLIT
PDF			FLEXIBLE

DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

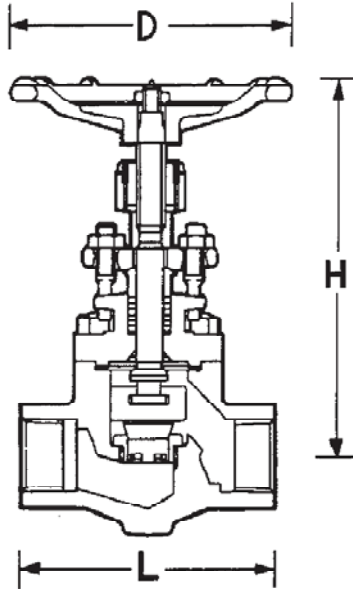
1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE
4. VALVES $\geq 10"$ AND $\geq 600"$ RATING SHALL HAVE BOSSES FOR BY-PASS CONNECTION ACC. TO API 600 AND MSS-SP 45, LOCATION E-F

MANDATORY STANDARDS:

API 598, API 600, ANSI B16.10, ANSI B16.34, ANSI B16.5, MSS-SP 45

NOTES:

GLOBE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	GLV 101
PRESSURE RATING CLASS	800
FACE	SW
CONSTRUCTION	
BODY	FORGED
BONNET TO BODY CONNECTION	BOLTED
HANDWHEEL	RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
DISC TYPE	SWIVEL PLUG
GEAR OPERATED	NO
BY-PASS VALVE	NO
NOMINAL SIZE	1/2" - 1 1/2"
MATERIALS	
BODY	A 350 Gr. LF2
BODY SEAT RING	AISI 304
DISC	AISI 304
STEM	AISI 304
STEM PACKING	GRAPHOIL
TRIM NUMBER	
DESIGN CONDITIONS	
PRESSURE RATING	API 602

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE

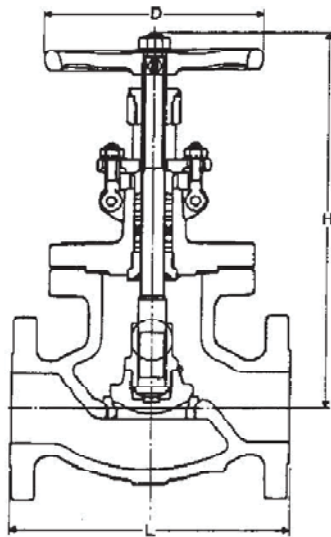
MANDATORY STANDARDS:

API 598, API 602, ANSI B16.11, ANSI B16.34

NOTES:

- a) VALVE DESIGN SHALL GENERALLY COMPLY WITH API 602
- b) LENGTH TO BE VERIFIED BY MANUFACTURER

GLOBE VALVE



DESIGN (ILLUSTRATIVE ONLY)

RATED Cv VALUES: (+-10%)

SIZE	2"	3"	4"	6"	8"	10"	12"
Cv	50	120	220	490	900	1400	2100

ITEM NO	GLV 111
PRESSURE RATING CLASS	300
FACE	RF
CONSTRUCTION	
BODY	CAST
BONNET TO BODY CONNECTION	BOLTED
HANDWHEEL	RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
DISC TYPE	PARABOLIC
GEAR OPERATED	NO
BY-PASS VALVE	NO
NOMINAL SIZE	2" - 8"
MATERIALS	
BODY	A 352 Gr. LCB
BODY SEAT RING	AISI 304
DISC	AISI 304
STEM	AISI 304
STEM PACKING	GRAPHOIL
TRIM NUMBER	
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34
FLUID	Kg/cm ² g °C

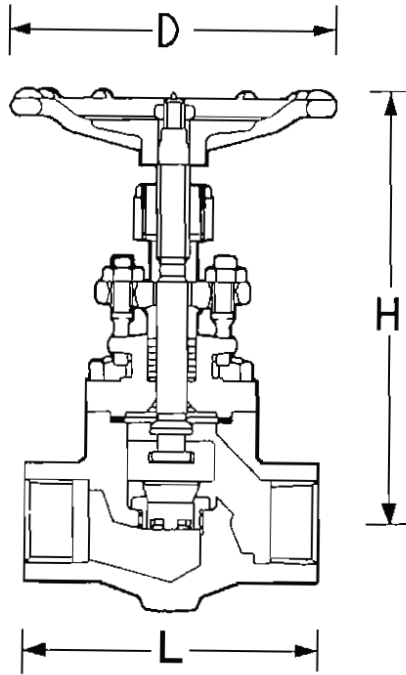
GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE
4. VALVES $\geq 10"$ AND $\geq 600"$ RATING SHALL HAVE BDSSES FOR BY-PASS CONNECTION ACC. TO ANSI B16.34 AND MSS-SP 45, LOCATION E-F

MANDATORY STANDARDS:

API 598, API 600, ANSI B16.10, ANSI B16.34, ANSI B16.5, MSS-SP 45

GLOBE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	GLV 201
PRESSURE RATING CLASS	800
FACE	SW
CONSTRUCTION	
BODY	FORGED
BONNET TO BODY CONNECTION	BOLTED
HANDWHEEL	RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
DISC TYPE	SWIVEL PLUG
GEAR OPERATED	NO
BY-PASS VALVE	NO
NOMINAL SIZE	1/2" - 1 1/2"
MATERIALS	
BODY	A 105
BODY SEAT RING	A 182 Gr. F6a STELLITED
DISC	A 182 Gr. F6a
STEM (NO CASTING)	13 Cr.
STEM PACKING	GRAFOIL/GRAPHITE
TRIM NUMBER	
DESIGN CONDITIONS	
PRESSURE RATING	API 602

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE

MANDATORY STANDARDS:

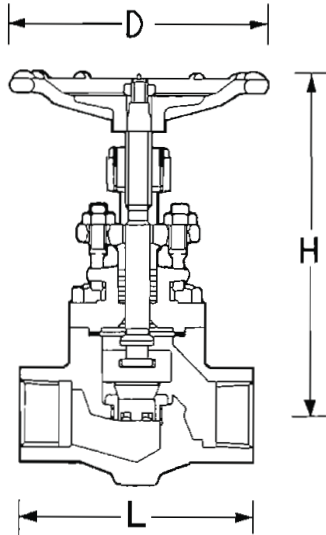
API 598, API 602, ANSI B16.11, ANSI B16.34

NOTES:

- a) VALVE DESIGN SHALL GENERALLY COMPLY WITH API 602
- b) LENGTH TO BE VERIFIED BY MANUFACTURER



GLOBE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	GLV 201S
PRESSURE RATING CLASS	800
FACE	SW IBR
CONSTRUCTION	
BODY	FORGED
BONNET TO BODY CONNECTION	BOLTED
HANDWHEEL	RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
DISC TYPE	SWIVEL PLUG
GEAR OPERATED	NO
BY-PASS VALVE	NO
NOMINAL SIZE	1/2" - 1 1/2"
MATERIALS	
BODY	A 105
BODY SEAT RING	A 182 Gr. F6a STELLITED
DISC	A 182 Gr. F6a
STEM	13 Cr.
STEM PACKING	GRAPHITE
TRIM NUMBER	
DESIGN CONDITIONS	
PRESSURE RATING	API 602

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GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE

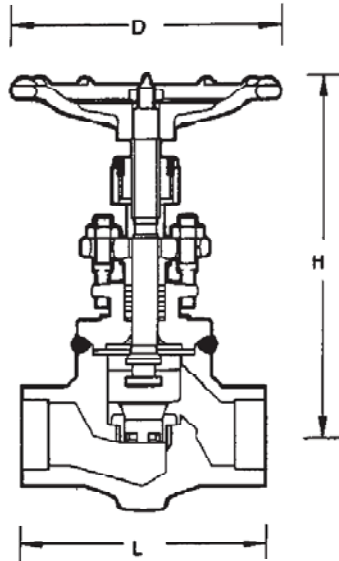
MANDATORY STANDARDS:

API 598, API 602, ANSI B16.11, ANSI B16.34

NOTES:

- a) VALVE DESIGN SHALL GENERALLY COMPLY WITH API 602
- b) LENGTH TO BE VERIFIED BY MANUFACTURER
- c) VALVE TO BE SUPPLIED WITH IBR CERTIFICATION

GLOBE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	GLV 204S
PRESSURE RATING CLASS	1500
FACE	SW
CONSTRUCTION	
BODY	FORGED
BONNET TO BODY CONNECTION	WELDED
HANDWHEEL	RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
DISC TYPE	SWIVEL PLUG
GEAR OPERATED	NO
BY-PASS VALVE	NO
NOMINAL SIZE	1/2" - 1 1/2"
MATERIALS	
BODY	A 105
BODY SEAT RING	A 1B2 Gr. F6a STELLITED
DISC	A 1B2 Gr. F6a STELLITED
STEM	13 Cr.
STEM PACKING	GRAPHOIL
TRIM NUMBER	
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE

MANDATORY STANDARDS:

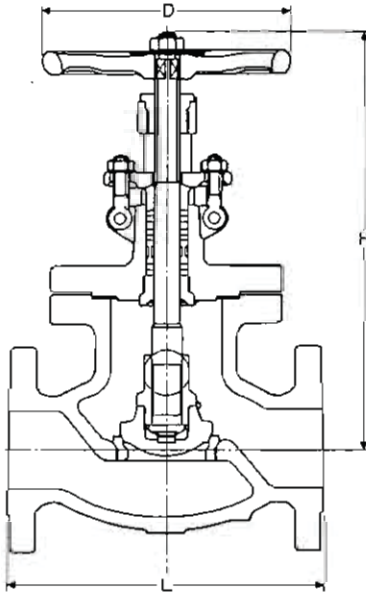
API 59B, API 602, ANSI B16.11, ANSI B16.34

NOTES:

- a) VALVE DESIGN SHALL GENERALLY COMPLY WITH API 602
- b) LENGTH TO BE VERIFIED BY MANUFACTURER
- c) VALVE TO BE SUPPLIED WITH IBR CERTIFICATION



GLOBE VALVE



DESIGN (ILLUSTRATIVE ONLY)

RATED Cv VALUES: (+ -10%)

SIZE	2"	3"	4"	6"	8"	10"	12"		
Cv	50	120	220	490	900	1400	2100		

ITEM NO	GLV 210
PRESSURE RATING CLASS	150
FACE	RF
CONSTRUCTION	
BODY	CAST
BONNET TO BODY CONNECTION	BOLTED
HANDWHEEL	RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
DISC TYPE	PARABOLIC
GEAR OPERATED	NO
BY-PASS VALVE	NO
NOMINAL SIZE	2" - 12"
MATERIALS	
BODY	A 216 Gr. WCB
BODY SEAT RING	A 105 STELLITED
DISC	A 216 Gr. WCB 13 Cr. FACING
STEM (NO CASTING)	13 Cr.
STEM PACKING	GRAFOIL/GRAPHITE
TRIM NUMBER	
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE
4. VALVES $\geq 10"$ AND $\geq 600"$ RATING SHALL HAVE BOSSES FOR BY-PASS CONNECTION ACC. TO ANSI B16.34 AND MSS-SP 45, LOCATION E-F

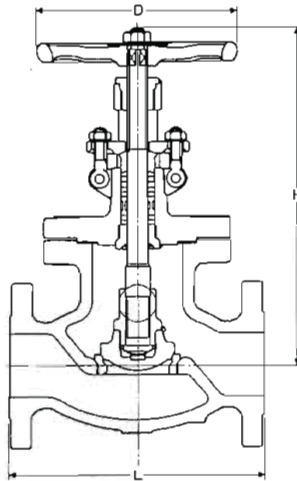
MANDATORY STANDARDS:

API 598, ANSI B16.10, ANSI B16.34, ANSI B16.5, MSS-SP 45

NOTES:



GLOBE VALVE



DESIGN (ILLUSTRATIVE ONLY)

RATED Cv VALUES: (+-10%)

SIZE	2"	3"	4"	6"	8"	10"	12"
Cv	50	120	220	490	900	1400	2100

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE
4. VALVES $\geq 10"$ AND $\geq 600"$ RATING SHALL HAVE BOSSES FOR BY-PASS CONNECTION ACC. TO ANSI B16.34 AND MSS-SP 45, LOCATION E-F

MANDATORY STANDARDS:

API 598, ANSI B16.10, ANSI B16.34, ANSI B16.5, MSS-SP 45

NOTES:

- a) VALVE TO BE SUPPLIED WITH IBR CERTIFICATION

ITEM NO	GLV 210S
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PRESSURE RATING CLASS	150
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FACE	RF IBR
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CONSTRUCTION

BODY	CAST
BONNET TO BODY CONNECTION	BOLTED
HANDWHEEL	RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
DISC TYPE	PARABOLIC
GEAR OPERATED	NO
BY-PASS VALVE	NO

NOMINAL SIZE	2" - 12"
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MATERIALS

BODY	A 216 Gr. WCB
BODY SEAT RING	A 105 STELLITED
DISC	A 216 Gr. WCB 13 Cr. FACING
STEM	13 Cr.
STEM PACKING	GRAPHITE
TRIM NUMBER	

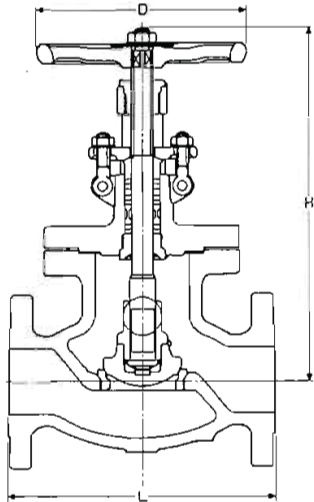
DESIGN CONDITIONS

PRESSURE RATING	ANSI B16.34
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rev.1



GLOBE VALVE



DESIGN (ILLUSTRATIVE ONLY)

RATED Cv VALUES: (+-10%)

SIZE	2"	3"	4"	6"	8"	10"	12"		
Cv	50	120	220	490	900	1400	2100		

ITEM NO	GLV 211
PRESSURE RATING CLASS	300
FACE	RF
CONSTRUCTION	
BODY	CAST
BONNET TO BODY CONNECTION	BOLTED
HANDWHEEL	RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
DISC TYPE	PARABOLIC
GEAR OPERATED	NO
BY-PASS VALVE	NO
NOMINAL SIZE	2" - 12"
MATERIALS	
BODY	A 216 Gr. WCB
BODY SEAT RING	A 105 STELLITED
DISC	A 216 Gr. WCB 13 Cr. FACING
STEM (NO CASTING)	13 Cr.
STEM PACKING	GRAFOIL
TRIM NUMBER	
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

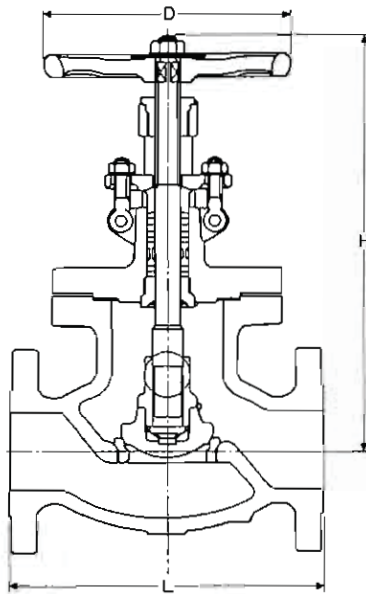
1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE
4. VALVES > = 10" AND > = 600" RATING SHALL HAVE BOSSES FOR BY-PASS CONNECTION ACC. TO ANSI B16.34 AND MSS-SP 45, LOCATION E-F

MANDATORY STANDARDS:

API 598, ANSI B16.10, ANSI B16.34, ANSI B16.5, MSS-SP 45

NOTES:

GLOBE VALVE



DESIGN (ILLUSTRATIVE ONLY)

RATED Cv VALUES: (+/-10%)

SIZE	2"	3"	4"	6"	8"	10"	12"
Cv	50	120	220	490	900	1400	2100

ITEM NO	GLV 212
PRESSURE RATING CLASS	600
FACE	RF
CONSTRUCTION	
BODY	CAST
BONNET TO BODY CONNECTION	BOLTED
HANDWHEEL	RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
DISC TYPE	PARABOLIC
GEAR OPERATED	NO
BY-PASS VALVE	NO
NOMINAL SIZE	2" - 8"
MATERIALS	
BODY	A 216 Gr. WCB
BODY SEAT RING	A 105 STELLITED
DISC	A 216 Gr. WCB 13 Cr. FACING
STEM	13 Cr.
STEM PACKING	Grafoil
TRIM NUMBER	
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE
4. VALVES $\geq 10"$ AND $\geq 600"$ RATING SHALL HAVE BOSSES FOR BY-PASS CONNECTION ACC. TO ANSI B16.34 AND MSS-SP 45, LOCATION E-F

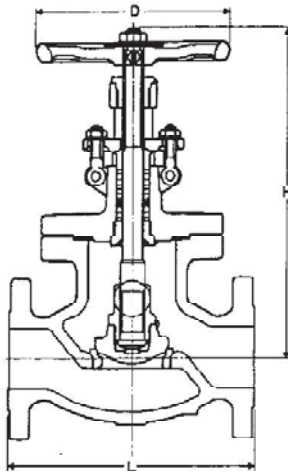
MANDATORY STANDARDS:

API 598, API 600, ANSI B16.10, ANSI B16.34, ANSI B16.5, MSS-SP 45

NOTES:



GLOBE VALVE



DESIGN (ILLUSTRATIVE ONLY)

RATED Cv VALUES: (+/-10%)

SIZE	2"	3"	4"	6"	8"	10"	12"
Cv	50	120	220	490	900	1400	2100

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE
4. VALVES > - 10" AND > - 600" RATING SHALL HAVE BOSSES FOR BY-PASS CONNECTION ACC. TO ANSI B16.34 AND MSS-SP 45, LOCATION E-F

MANDATORY STANDARDS:

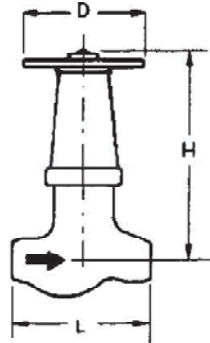
API 598, API 600, ANSI B16.10, ANSI B16.34, ANSI B16.5, MSS-SP 45

NOTES:

- a) VALVE TO BE SUPPLIED WITH IBR CERTIFICATION

ITEM NO	GLV 212S
PRESSURE RATING CLASS	600
FACE	RF
CONSTRUCTION	
BODY	CAST
BONNET TO BODY CONNECTION	BOLTED
HANDWHEEL	RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
DISC TYPE	PARABOLIC
GEAR OPERATED	NO
BY-PASS VALVE	NO
NOMINAL SIZE	2" - 8"
MATERIALS	
BODY	A 216 Gr. WCB
BOOY SEAT RING	A 182 Gr. F6a STELLITED
DISC	A 182 Gr. F6a STELLITED
STEM	13 Cr.
STEM PACKING	GRAPHOIL
TRIM NUMBER	
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GLOBE VALVE



DESIGN (ILLUSTRATIVE ONLY)

RATED Cv VALUES: (+-10%)

SIZE	2"	3"	4"	6"	8"	10"	12"	14"	16"
Cv	50	120	220	490	900		30		

ITEM NO	GLV 216S
PRESSURE RATING CLASS	1500
FACE	BW
CONSTRUCTION	
BODY	CAST OR FORGED a)
BONNET TO BODY CONNECTION	PRESSURE SEAL c)
HANDWHEEL	NON-RISING c)
STEM	RISING
STEM AND YOKE TYPE	OS & Y
DISC TYPE	PARABOLIC
GEAR OPERATED	YES > = 8"
BY-PASS VALVE	NO
NOMINAL SIZE	1 1/2" - 8"
MATERIALS	
BODY	A 216 Gr. WCB
BODY SEAT RING	INTEGRAL STELLITED
DISC	A 182 Gr. F6a STELLITED
STEM	13 Cr.
STEM PACKING	GRAPHOIL
TRIM NUMBER	
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE
4. VALVES > = 10" AND > = 600" RATING SHALL HAVE BOSSES FOR BY-PASS CONNECTION ACC. TO ANSI B16.34 AND MSS-SP 45, LOCATION E-F

MANDATORY STANDARDS:

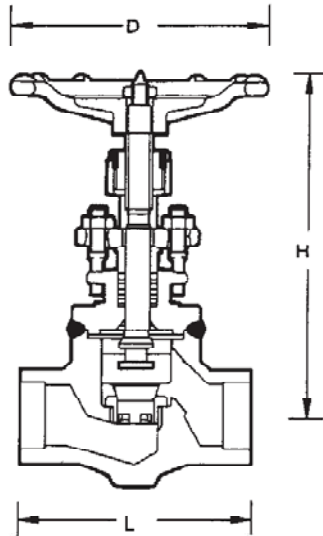
API 598, API 600, ANSI B16.10, ANSI B16.34, ANSI B16.5, MSS-SP 45

NOTES:

- a) END TO END DIMENSION SHALL BE SHORT PATTERN
- b) VALVE TO BE SUPPLIED WITH IBR CERTIFICATION
- c) WELDED BONNET AND RISING STEM ARE ACCEPTABLE FOR SIZE 1 1/2"
- d) VALVES > = 6" SHALL HAVE YOKE BUSHING THRUST BEARINGS



GLOBE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	GLV 305S
PRESSURE RATING CLASS	2500
FACE	SW
CONSTRUCTION	
BODY	FORGED
BONNET TO BODY CONNECTION	WELDED
HANDWHEEL	RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
DISC TYPE	SWIVEL PLUG
GEAR OPERATED	NO
BY-PASS VALVE	NO
NOMINAL SIZE	1/2" - 1 1/2"
MATERIALS	
BODY	A 182 Gr. F22
BODY SEAT RING	A 182 Gr. F6a STELLITED
DISC	A 182 Gr. F6a STELLITED
STEM	13 Cr.
STEM PACKING	GRAPHOIL
TRIM NUMBER	
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE

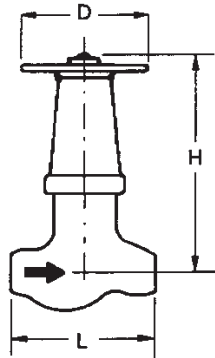
MANDATORY STANDARDS:

API 598, API 602, ANSI B16.11, ANSI B16.34

NOTES:

- a) VALVE DESIGN SHALL GENERALLY COMPLY WITH API 602
- b) LENGTH TO BE VERIFIED BY MANUFACTURER
- c) VALVE TO BE SUPPLIED WITH IBR CERTIFICATION

GLOBE VALVE



DESIGN (ILLUSTRATIVE ONLY)

RATED Cv VALUES: (+ -10%)							
SIZE	2"	3"	4"	6"	8"		
Cv	50	120	220	490	900		

ITEM NO	GLV 326S
PRESSURE RATING CLASS	2500
FACE	BW
CONSTRUCTION	
BODY	CAST OR FORGED a)
BDNNET TO BODY CONNECTION	PRESSURE SEAL
HANDWHEEL	NON-RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
DISC TYPE	PARABOLIC
GEAR OPERATED	NO
BY-PASS VALVE	NO
NOMINAL SIZE	2" - 4"
MATERIALS	
BODY	A 217 Gr. WC9
BODY SEAT RING	INTEGRAL STELLITED
DISC	A 182 Gr. F6a STELLITED
STEM	13 Cr.
STEM PACKING	GRAPHOIL
TRIM NUMBER	
DESIGN CDNDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE
4. VALVES > = 10" AND > = 600" RATING SHALL HAVE BOSSES FOR BY-PASS CONNECTION ACC. TO ANSI B16.34 AND MSS-SP 45, LOCATION E-F

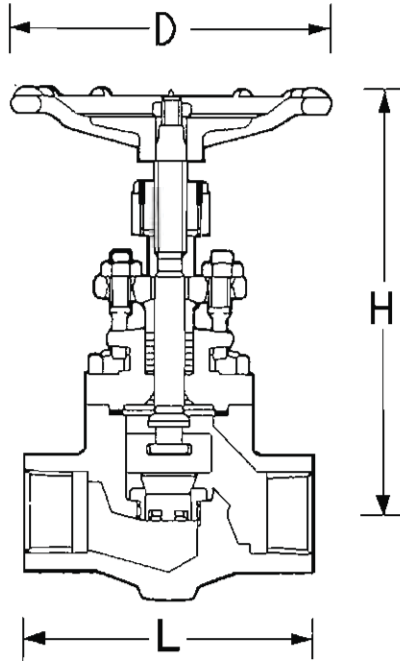
MANDATORY STANDARDS:

API 598, API 600, ANSI B16.10, ANSI B16.34, ANSI B16.5, MSS-SP 45

NOTES:

- a) END TO END DIMENSION SHALL BE SHORT PATTERN
- b) VALVE TO BE SUPPLIED WITH IBR CERTIFICATION

GLOBE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	GLV	401
PRESSURE RATING CLASS	800	
FACE	SW	
CONSTRUCTION		
BODY	FORGED	
BONNET TO BODY CONNECTION	BOLTED	
HANDWHEEL	RISING	
STEM	RISING	
STEM AND YOKE TYPE	OS & Y	
DISC TYPE	SWIVEL PLUG	
GEAR OPERATED	NO	
BY-PASS VALVE	NO	
NOMINAL SIZE	1/2" - 1 1/2"	
MATERIALS		
BODY	A182 GR.F316L	
BODY SEAT RING	A182 GR.F316L	
DISC	A182 GR.F316L	
STEM	SS316L	
STEM PACKING	GRAFOIL	
TRIM NUMBER		
DESIGN CONDITIONS		
PRESSURE RATING	API 602	

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GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE

MANDATORY STANDARDS:

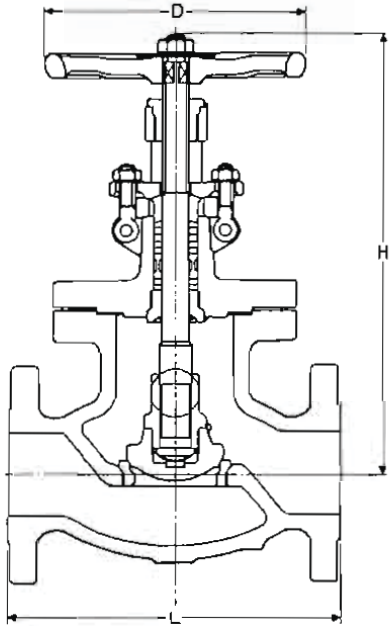
API 598, API 602, ANSI B16.11, ANSI B16.34

NOTES:

- a) VALVE DESIGN SHALL GENERALLY COMPLY WITH API 602
- b) LENGTH TO BE VERIFIED BY MANUFACTURER



GLOBE VALVE



DESIGN (ILLUSTRATIVE ONLY)

RATED Cv VALUES: (+-10%)

SIZE	2"	3"	4"	6"	8"	10"	12"		
Cv	50	120	220	490	900	1400	2100		

ITEM NO	GLV 410
PRESSURE RATING CLASS	150
FACE	RF
CONSTRUCTION	
BODY	CAST
BONNET TO BODY CONNECTION	BOLTED
HANDWHEEL	RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
DISC TYPE	PARABOLIC
GEAR OPERATED	NO
BY-PASS VALVE	NO
NOMINAL SIZE	2"-24"
MATERIALS	
BODY	A 351 GR.CF3M
BODY SEAT RING	A182 GR.F316L
DISC	AISI 316L
STEM	AISI 316L
STEM PACKING	GRAFOIL
TRIM NUMBER	
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

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GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE
4. VALVES $\geq 10"$ AND $\geq 600"$ RATING SHALL HAVE BOSSES FOR BY-PASS CONNECTION ACC. TO ANSI B16.34 AND MSS-SP 45, LOCATION E-F

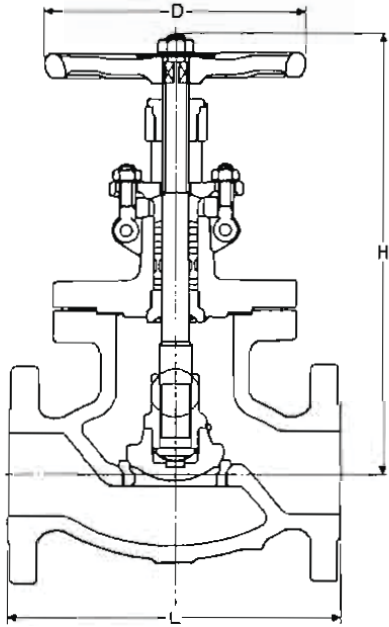
MANDATORY STANDARDS:

API 598, API 600, ANSI B16.10, ANSI B16.34, ANSI B16.5, MSS-SP 45

NOTES:



GLOBE VALVE



DESIGN (ILLUSTRATIVE ONLY)

RATED Cv VALUES: (+-10%)

SIZE	2"	3"	4"	6"	8"	10"	12"
Cv	50	120	220	490	900	1400	2100

ITEM NO	GLV411
PRESSURE RATING CLASS	300
FACE	RF
CONSTRUCTION	
BODY	CAST
BONNET TO BODY CONNECTION	BOLTED
HANDWHEEL	RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
DISC TYPE	PARABOLIC
GEAR OPERATED	NO
BY-PASS VALVE	NO
NOMINAL SIZE	2"-24"
MATERIALS	
BODY	A 351 GR.CF3M
BODY SEAT RING	A182 GR.F316L
DISC	AISI 316L
STEM	AISI 316L
STEM PACKING	GRAFOIL
TRIM NUMBER	
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

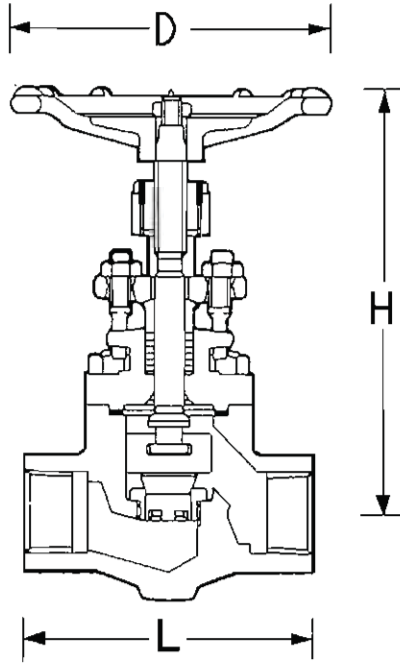
1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE
4. VALVES $\geq 10"$ AND $\geq 600"$ RATING SHALL HAVE BOSSES FOR BY-PASS CONNECTION ACC. TO ANSI B16.34 AND MSS-SP 45, LOCATION E-F

MANDATORY STANDARDS:

API 598, API 600, ANSI B16.10, ANSI B16.34, ANSI B16.5, MSS-SP 45

NOTES:

GLOBE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	GLV 501
PRESSURE RATING CLASS	800
FACE	SW
CONSTRUCTION	
BODY	FORGED
BONNET TO BODY CONNECTION	BOLTED
HANDWHEEL	RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
DISC TYPE	SWIVEL PLUG
GEAR OPERATED	NO
BY-PASS VALVE	NO
NOMINAL SIZE	1/2" - 1 1/2"
MATERIALS	
BODY	A 182 Gr. F304
BODY SEAT RING	A 182 Gr. F304
DISC	A 182 Gr. F304
STEM	A 276 Gr. 304
STEM PACKING	GRAFOIL
TRIM NUMBER	
DESIGN CONDITIONS	
PRESSURE RATING	API 602

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE

MANDATORY STANDARDS:

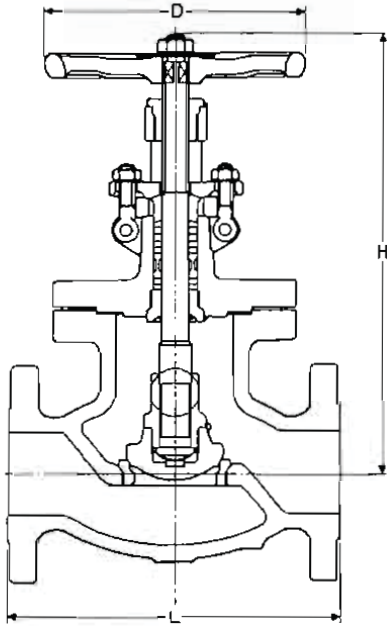
API 598, API 602, ANSI B16.11, ANSI B16.34

NOTES:

- a) VALVE DESIGN SHALL GENERALLY COMPLY WITH API 602
- b) LENGTH TO BE VERIFIED BY MANUFACTURER



GLOBE VALVE



DESIGN (ILLUSTRATIVE ONLY)

RATED Cv VALUES: (+-10%)

SIZE	2"	3"	4"	6"	8"	10"	12"
Cv	50	120	220	490	900	1400	2100

ITEM NO	GLV 510
PRESSURE RATING CLASS	150
FACE	RF
CONSTRUCTION	
BODY	CAST
BONNET TO BODY CONNECTION	BOLTED
HANDWHEEL	RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
DISC TYPE	PARABOLIC
GEAR OPERATED	NO
BY-PASS VALVE	NO
NOMINAL SIZE	2" - 8"
MATERIALS	
BODY	A 351 Gr. CF8
BODY SEAT RING	A 182 Gr. F304
DISC	AISI 304
STEM	A 276 Gr. 304
STEM PACKING	GRAFOIL
TRIM NUMBER	
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

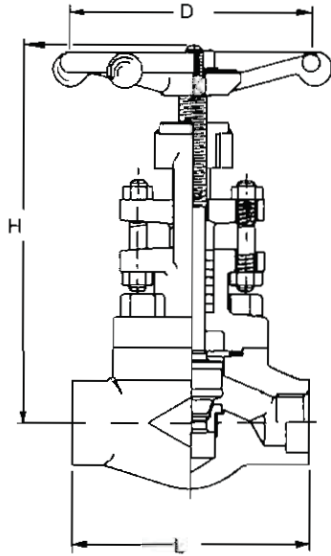
1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE
4. VALVES $\geq 10"$ AND $\geq 600"$ RATING SHALL HAVE BOSSES FOR BY-PASS CONNECTION ACC. TO ANSI B16.34 AND MSS-SP 45, LOCATION E-F

MANDATORY STANDARDS:

API 598, API 600, ANSI B16.10, ANSI B16.34, ANSI B16.5, MSS-SP 45

NOTES:

NEEDLE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	NEV 501	
PRESSURE RATING CLASS	800	
FACE	SW	
CONSTRUCTION		
BODY	FORGED b)	
BONNET TO BODY CONNECTION	BOLTED	
HANDWHEEL	RISING	
STEM	RISING	
STEM AND YOKE TYPE	OS & Y	
DISC TYPE	SWIVEL NEEDLE	
GEAR OPERATED	NO	
BY-PASS VALVE	NO	
NOMINAL SIZE	1/2" - 1 1/2"	
MATERIALS		
BODY	A 182 Gr. F316	
BODY SEAT RING	INTEGRAL STELLITED	
DISC	A 182 Gr. F316 STELLITED	
STEM	A 276 Gr. 316	
STEM PACKING	GRAFOIL	
TRIM NUMBER		
DESIGN CONDITIONS		
PRESSURE RATING	API 602	
FLUID	Kg/cm ² g	°C

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE

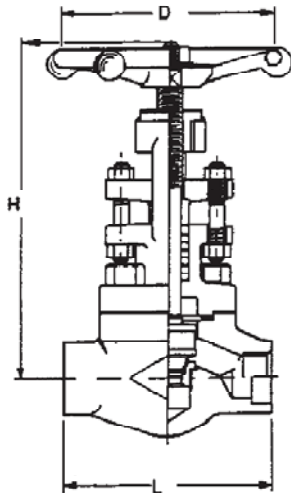
MANDATORY STANDARDS:

API 598, API 602, ANSI B16.11, ANSI B16.34

NOTES:

- a) VALVE DESIGN SHALL GENERALLY COMPLY WITH API 602
- b) REDUCED BORE (LOW VOLUME TYPE)

NEEDLE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	NEV 501S
PRESSURE RATING CLASS	800
FACE	SW
CONSTRUCTION	
BODY	FORGED b)
BONNET TO BODY CONNECTION	BOLTED
HANDWHEEL	RISING
STEM	RISING
STEM AND YOKE TYPE	DS & Y
DISC TYPE	SWIVEL NEEDLE
GEAR OPERATED	NO
BY-PASS VALVE	NO
NOMINAL SIZE	1/2" - 1 1/2"
MATERIALS	
BODY	A 182 Gr. F316
BODY SEAT RING	INTEGRAL STELLITED
DISC	A 182 Gr. F316 STELLITED
STEM	A 276 Gr. 316
STEM PACKING	GRAPHOIL
TRIM NUMBER	
DESIGN CONDITIONS	
PRESSURE RATING	API 602

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE

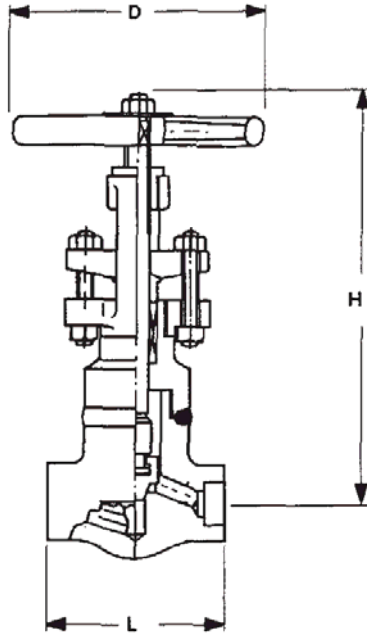
MANDATORY STANDARDS:

API 598, API 602, ANSI B16.11, ANSI B16.34

NOTES:

- a) VALVE DESIGN SHALL GENERALLY COMPLY WITH API 602
- b) REDUCED BORE (LOW VOLUME TYPE)
- c) VALVE TO BE SUPPLIED WITH IBR CERTIFICATION

NEEDLE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	NEV 502S
PRESSURE RATING CLASS	1500
FACE	SW
CONSTRUCTION	
BODY	FORGED b)
BONNET TO BODY CONNECTION	WELDED
HANDWHEEL	RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
DISC TYPE	SWIVEL NEEDLE
GEAR OPERATED	NO
BY-PASS VALVE	NO
NOMINAL SIZE	1/2" - 1 1/2"
MATERIALS	
BODY	A 182 Gr. F316
BODY SEAT RING	INTEGRAL STELLITED
DISC	A 182 Gr. F316 STELLITED
STEM	A 276 Gr. 316
STEM PACKING	GRAPHOIL
TRIM NUMBER	
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE

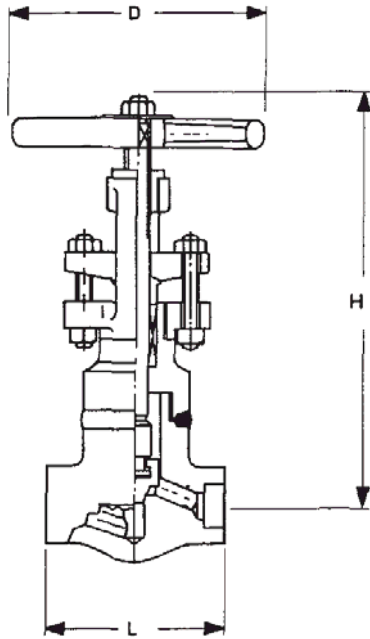
MANDATORY STANDARDS:

API 598, API 602, ANSI B16.11, ANSI B16.34

NOTES:

- a) VALVE DESIGN SHALL GENERALLY COMPLY WITH API 602
- b) REDUCED BORE (LOW VOLUME TYPE)
- c) VALVE TO BE SUPPLIED WITH IBR CERTIFICATION

NEEDLE VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	NEV 503S
PRESSURE RATING CLASS	2500
FACE	SW
CONSTRUCTION	
BODY	FORGED b)
BONNET TO BODY CONNECTION	WELDED
HANDWHEEL	RISING
STEM	RISING
STEM AND YOKE TYPE	OS & Y
DISC TYPE	SWIVEL NEEDLE
GEAR OPERATED	NO
BY-PASS VALVE	NO
NOMINAL SIZE	1/2" - 1 1/2"
MATERIALS	
BODY	A 182 Gr. F316
BODY SEAT RING	INTEGRAL STELLITED
DISC	A 182 Gr. F316 STELLITED
STEM	A 276 Gr. 316
STEM PACKING	GRAPHOIL
TRIM NUMBER	
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED
2. GLAND SHALL BE SUITABLE FOR REPACKING UNDER PRESSURE WHEN VALVE IS FULLY OPEN
3. IF NOT OTHERWISE STATED THE VALVES SHALL BE FULL BORE

MANDATORY STANDARDS:

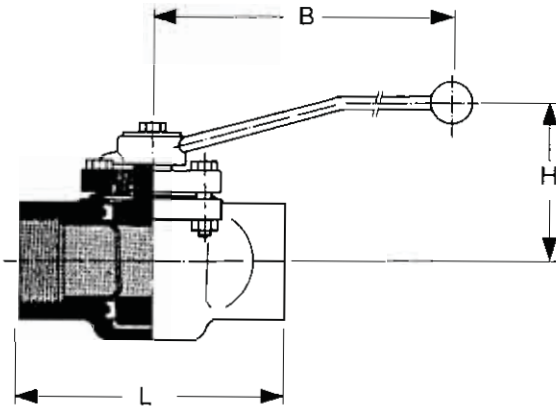
API 598, API 602, ANSI B16.11, ANSI B16.34

NOTES:

- a) VALVE DESIGN SHALL GENERALLY COMPLY WITH API 602
- b) REDUCED BORE (LOW VOLUME TYPE)
- c) VALVE TO BE SUPPLIED WITH IBR CERTIFICATION



PLUG VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	PLV 201
PRESSURE RATING CLASS	600
FACE	TREADED (NPT)
CONSTRUCTION	
BODY	FULL BORE NON-LUBRICATED
PLUG	TAPER PLUG
WRENCH OPERATED	YES
GEAR OPERATED	NO
FIRE SAFE	NO
NOMINAL SIZE	1/2" - 1"
MATERIALS	
BODY	A 105 a)
PLUG	A 105 CHROMEPLATED a)
BODY SEAT RING	REINFORCED PTFE
STEM PACKING	PTFE
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED

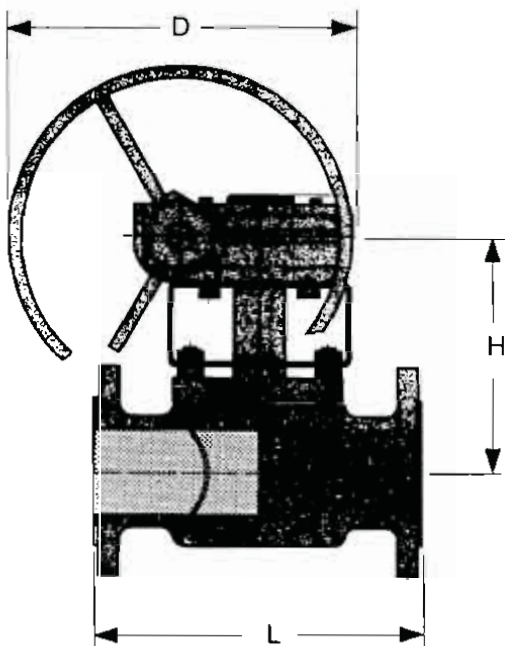
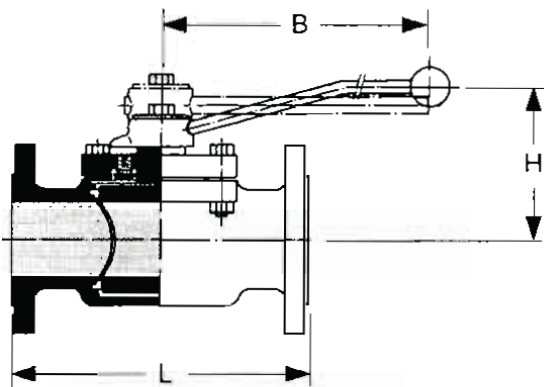
MANDATORY STANDARDS:

API 598, API 6D, ANSI B16.11, ANSI B16.34

NOTES:

a) EQUIVALENT CAST MATERIAL IS ACCEPTABLE

PLUG VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	PLV 202
PRESSURE RATING CLASS	150
FACE	RF
CONSTRUCTION	
BODY	NON-LUBRICATED FULL BORE
PLUG	TAPER PLUG
WRENCH OPERATED	1 1/2" - 4"
GEAR OPERATED	6"
FIRE SAFE	NO
NOMINAL SIZE	1 1/2" - 6"
MATERIALS	
BODY	A 216 Gr. WCB
PLUG	A 105 CHROMEPLATED a)
BODY SEAT RING	REINFORCED PTFE
STEM PACKING	PTFE
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED

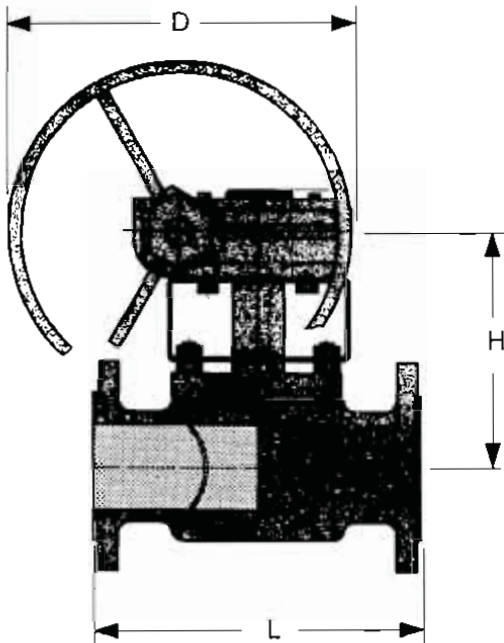
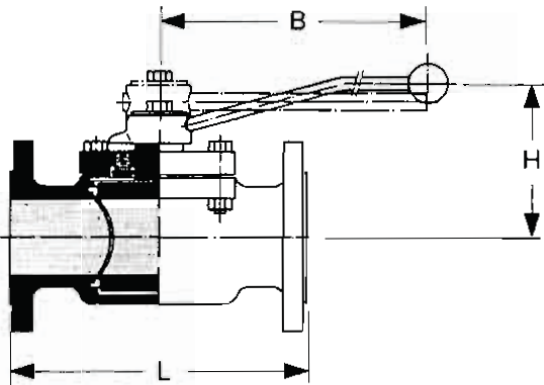
MANDATORY STANDARDS:

API 598, API 599, ANSI B16.10, ANSI B16.5

NOTES:

a) EQUIVALENT CAST MATERIAL IS ACCEPTABLE

PLUG VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	PLV 205
PRESSURE RATING CLASS	300
FACE	RF
CONSTRUCTION	
BODY	NON-LUBRICATED FULL BORE
PLUG	TAPER PLUG
WRENCH OPERATED	1 1/2" - 4"
GEAR OPERATED	6"
FIRE SAFE	NO
NOMINAL SIZE	1 1/2" - 6"
MATERIALS	
BODY	A 216 Gr. WCB
PLUG	A 105 CHROMEPLATED a)
BODY SEAT RING	REINFORCED PTFE
STEM PACKING	PTFE
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED

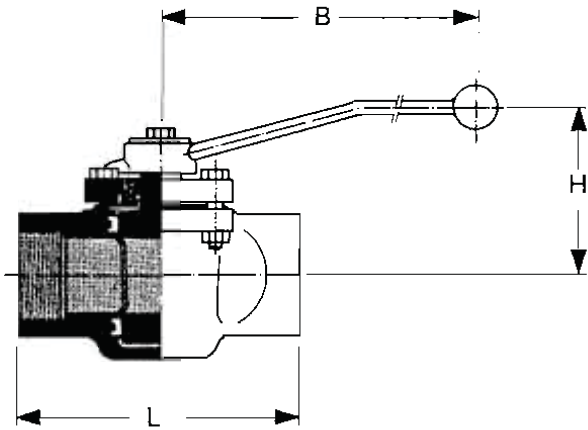
MANDATORY STANDARDS:

API 598, API 599, ANSI B16.10, ANSI B16.5

NOTES:

a) EQUIVALENT CAST MATERIAL IS ACCEPTABLE

PLUG VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	PLV 501
PRESSURE RATING CLASS	600
FACE	TREADED (NPT)
CONSTRUCTION	
BODY	FULL BORE NON-LUBRICATED
PLUG	TAPER PLUG
WRENCH OPERATED	YES
GEAR OPERATED	NO
FIRE SAFE	NO
NOMINAL SIZE	1/2" - 1"
MATERIALS	
BODY	AISI 316
PLUG	AISI 316
BODY SEAT RING	REINFORCED PTFE
STEM PACKING	PTFE
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

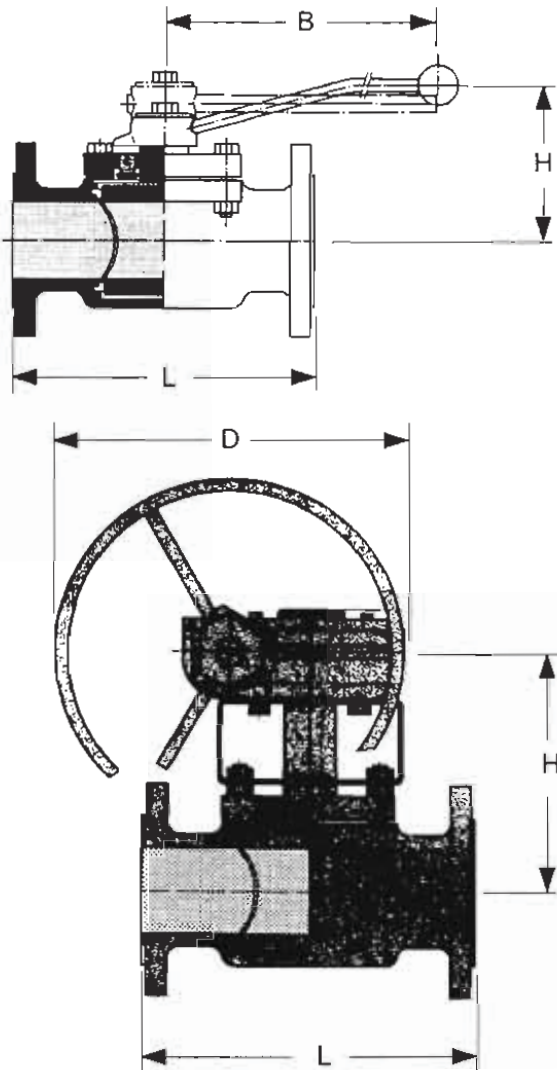
1. COPPER AND COPPER ALLOYS NOT PERMITTED

MANDATORY STANDARDS:

API 598, API 6D, ANSI B16.11, ANSI B16.34

NOTES:

PLUG VALVE



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	PLV 510
PRESSURE RATING CLASS	150
FACE	RF
CONSTRUCTION	
BODY	NON-LUBRICATED FULL BORE
PLUG	TAPER PLUG
WRENCH OPERATED	1 1/2" - 4"
GEAR OPERATED	6"
FIRE SAFE	NO
NOMINAL SIZE	1 1/2" - 6"
MATERIALS	
BODY	A 351 Gr. CF8M
PLUG	A 182 Gr. F316 a)
BODY SEAT RING	REINFORCED PTFE
STEM PACKING	PTFE
DESIGN CONDITIONS	
PRESSURE RATING	ANSI B16.34

GENERAL

1. COPPER AND COPPER ALLOYS NOT PERMITTED

MANDATORY STANDARDS:

API 598, API 599, ANSI B16.10, ANSI B16.5

NOTES:

a) EQUIVALENT CAST MATERIAL IS ACCEPTABLE



GAV500C :FLANGED GATE VALVE ; 150# ;CPVC BODY(ASTM F441);POLY PROPYLENE PLUG; EPDM SEALS ;TAPERED CYLINDRICAL PLUG DESIGN; BOLTED BONNET; FLAT FACE; FLANGE DIMENSION AS PER ASME B16.1 .

CHV500C :SOCKET WELD CHECK VALVE ; 150# ; H OR V ; UNION OR BOLTED COVER ; BALL TYPE CPVC BODY(ASTM F441);TRIM AS PER BODY MATERIAL ; SOCKET WELD ENDS AS PER ASME B16.11 MANUFACTURER'S STANDARD CONSTRUCTION .

BAV500C :SOCKET WELD BALL VALVE ; 150# ; FLOATING BALL;FULL PORT ;WRENCH OPERATED ; CPVC BODY(ASTM F441);CPVC BALL;VITON O RING SEALS; SOCKET WELD ENDS AS PER ASME B16.11 MANUFACTURER'S STANDARD CONSTRUCTION .

BAV501C : FLANGED BALL VALVE ; 150# ; FLOATING BALL;FULL PORT ;WRENCH OPERATED ; CPVC BODY(ASTM F441);CPVC BALL;VITON O RING SEALS; FLAT FACE; FLANGE DIMENSION AS PER ASME B16.1 ;MANUFACTURER'S STANDARD CONSTRUCTION .

DPV500 : DIAPHRAGM VALVE :150#; RUBBER DIAPHRAGM; FLANGED END; BODY ASTM A216GR.WCB RUBBER LINED ; BONNET ASTM A216 GR.WCB ; STEM/COMPRESSOR 13% CR. ; MANUFACTURER'S STANDARD CONSTRUCTION.

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DPV501 : DIAPHRAGM VALVE :150#; RUBBER DIAPHRAGM; FLANGED END; BODY AUSTENITIC SS 304 ; BONNET SS304 ; STEM/COMPRESSOR SS304 ; MANUFACTURER'S STANDARD CONSTRUCTION.

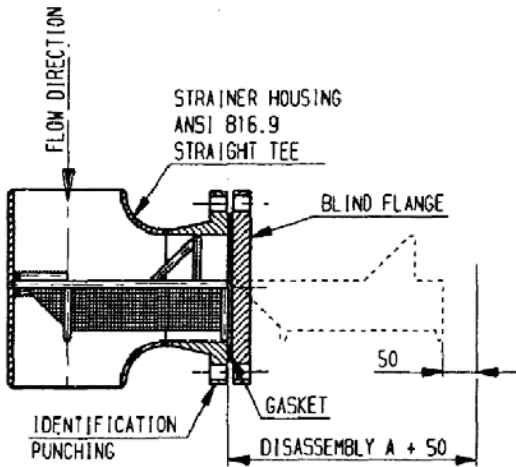
rev.1

	PROJECTS & DEVELOPMENT INDIA LTD	TFL-PDS-600	0
		DOCUMENT NO	REV

STRAINER DATA SHEETS



T -TYPE STRAINER



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	T TS 210	
PRESSURE RATING CLASS	150	
FACE	RF	
CONSTRUCTION		
BODY	CAST	
BODY TO BONNET CONNECTION	BOLTED	
STRAINER	PERFORATED PLATE	
STRAINER HOLES, SIZE	Ø 1,5 MM	
NOS STRAINER HOLES / SQ.CM	18	
BLOW OFF CONNECTION	NOTE 1	
NOMINAL SIZE	2" - 24"	
MATERIALS		
BODY	A 216 Gr. WCB	
STRAINER	AISI 304	
DESIGN CONDITIONS		
PRESSURE RATING	ASME 816.34	
FLUID	Kg/cm ² g	°C

GENERAL

1. STRAINER MUST BE REMOVABLE
2. COPPER AND COPPER ALLOYS NOT PERMITTED

MANDATORY STANDARDS:

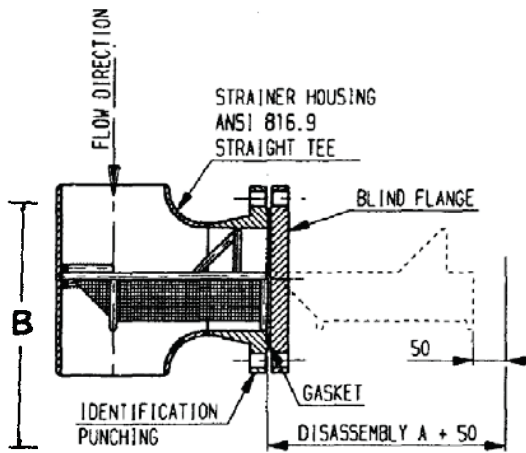
ASME B16.34, ASME B16.5, MSS-SP 45

NOTES:

1. STRAINER SIZE	BLOW OFF CONNECTION
2" - 4"	3/4" NPT PLUG
6" - 8"	1" NPT PLUG
10"	1 1/4" NPT PLUG
12" - 24"	1 1/2" NPT PLUG



T-TYPE STRAINER



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	TTS 510	
PRESSURE RATING CLASS	150	
FACE	RF	
CONSTRUCTION		
BODY	CAST	
BODY TO BONNET CONNECTION	BOLTED	
STRAINER	PERFORATED PLATE	
STRAINER HOLES, SIZE	Ø 1.5 MM	
NOS STRAINER HOLES / SQ. CM	18	
BLOW OFF CONNECTION	NOTE 1	
NOMINAL SIZE	2" - 24"	
MATERIALS		
BODY	A 351 Gr. CF8	
STRAINER	AISI 304	
DESIGN CONDITIONS		
PRESSURE RATING	ASME B16.34	
FLUID	Kg/cm ² g	°C

GENERAL

1. STRAINER MUST BE REMOVABLE
2. COPPER AND COPPER ALLOYS NOT PERMITTED

MANDATORY STANDARDS:

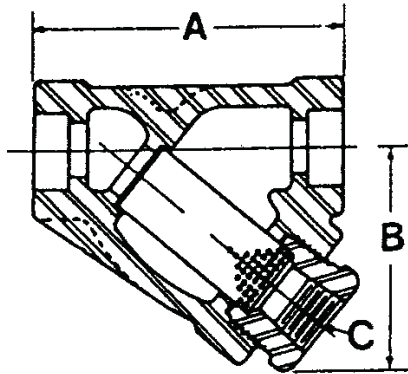
ASME B16.34, ASME B16.5, MSS-SP 45

NOTES:

STRAINER SIZE	BLOW OFF CONNECTION
2" - 4"	3/4" NPT PLUG
6" - 8"	1" NPT PLUG
10"	1 1/4" NPT PLUG
12" - 24"	1 1/2" NPT PLUG



Y-TYPE STRAINER



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	YTS 201	
PRESSURE RATING CLASS	600	
FACE	SW	
CONSTRUCTION		
BODY	FORGED	
BODY TO BONNET CONNECTION	SCREWED	
STRAINER	PERFORATED PLATE	
STRAINER HOLES, SIZE	Ø 0.8 MM	
NOS STRAINER HOLES / SQ.CM	40	
BLOW OFF CONNECTION	NOTE 1	
NOMINAL SIZE	1/2" - 1 1/2"	
MATERIALS		
BODY	A 105	
STRAINER	AISI 304	
DESIGN CONDITIONS		
PRESSURE RATING	ASME B16.34	
FLUID	Kg/cm ² g	°C

GENERAL

1. STRAINER MUST BE REMOVABLE
2. COPPER AND COPPER ALLOYS NOT PERMITTED

MANDATORY STANDARDS:

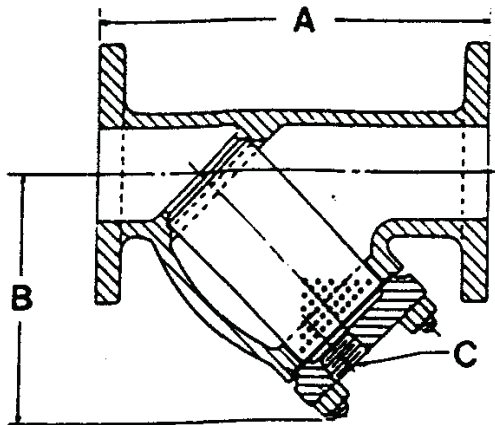
ASME B16.11, ASME B16.34

NOTES:

- | | |
|------------------|---------------------|
| 1. STRAINER SIZE | BLOW OFF CONNECTION |
| 1/2" - 3/4" | 1/4" NPT PLUG |
| 1" - 1 1/2" | 3/4" NPT PLUG |



Y-TYPE STRAINER



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	YTS 210	
PRESSURE RATING CLASS	150	
FACE	RF	
CONSTRUCTION		
BODY	CAST	
BODY TO BONNET CONNECTION	BOLTED	
STRAINER	PERFORATED PLATE	
STRAINER HOLES, SIZE	Ø 1,5 MM	
NOS STRAINER HOLES / SQ.CM	18	
BLOW OFF CONNECTION	NOTE 1	
NOMINAL SIZE	2" - 24"	
MATERIALS		
BODY	A 216 Gr. WCB	
STRAINER	AISI 304	
DESIGN CONDITIONS		
PRESSURE RATING	ASME B16.34	
FLUID	Kg/cm ² g	°C

GENERAL

1. STRAINER MUST BE REMOVABLE
2. COPPER AND COPPER ALLOYS NOT PERMITTED

MANDATORY STANDARDS:

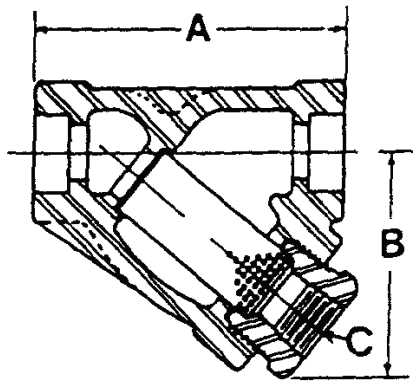
ASME B16.34, ASME B16.5, MSS-SP 45

NOTES:

1. STRAINER SIZE	BLOW OFF CONNECTION
2" - 4"	3/4" NPT PLUG
6" - 8"	1" NPT PLUG
10"	1 1/4" NPT PLUG
12" - 24"	1 1/2" NPT PLUG



Y-TYPE STRAINER



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	YTS 501	
PRESSURE RATING CLASS	600	
FACE	SW	
CONSTRUCTION		
BODY	FORGED	
BODY TO BONNET CONNECTION	SCREWED	
STRAINER	PERFORATED PLATE	
STRAINER HOLES, SIZE	Ø 0.8 MM	
NOS STRAINER HOLES / SQ.CM	40	
BLOW OFF CONNECTION	NOTE 1	
NOMINAL SIZE	1/2" - 1 1/2"	
MATERIALS		
BODY	A 182 Gr. F304	
STRAINER	AISI 304	
DESIGN CONDITIONS		
PRESSURE RATING	ASME B16.34	
FLUID	Kg/cm ² g	°C

GENERAL

1. STRAINER MUST BE REMOVABLE
2. COPPER AND COPPER ALLOYS NOT PERMITTED

MANDATORY STANDARDS:

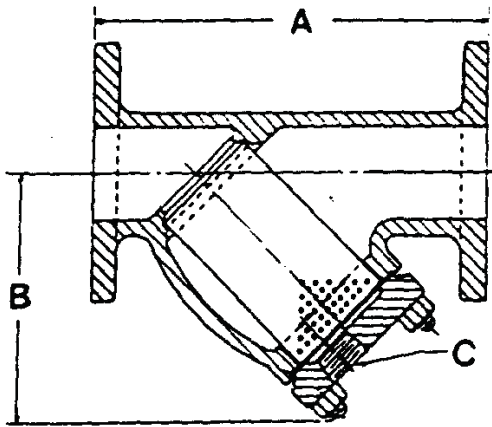
ASME B16.11, ASME B16.34

NOTES:

- | | |
|------------------|---------------------|
| 1. STRAINER SIZE | BLOW OFF CONNECTION |
| 1/2" - 3/4" | 1/4" NPT PLUG |
| 1" - 1 1/2" | 3/4" NPT PLUG |



Y-TYPE STRAINER



DESIGN (ILLUSTRATIVE ONLY)

ITEM NO	YTS 510	
PRESSURE RATING CLASS	150	
FACE	RF	
CONSTRUCTION		
BODY	CAST	
BODY TO BONNET CONNECTION	BOLTED	
STRAINER	PERFORATED PLATE	
STRAINER HOLES, SIZE	Ø 1,5 MM	
NOS STRAINER HOLES / SQ.CM	18	
BLOW OFF CONNECTION	NOTE 1	
NOMINAL SIZE	2" - 24"	
MATERIALS		
BODY	A 351 Gr. CF8	
STRAINER	AISI 304	
DESIGN CONDITIONS		
PRESSURE RATING	ASME B16.34	
FLUID	Kg/cm ² g	°C

GENERAL

1. STRAINER MUST BE REMOVABLE
2. COPPER AND COPPER ALLOYS NOT PERMITTED

MANDATORY STANDARDS:

ASME B16.34, ASME B16.5, MSS-SP 45

NOTES:

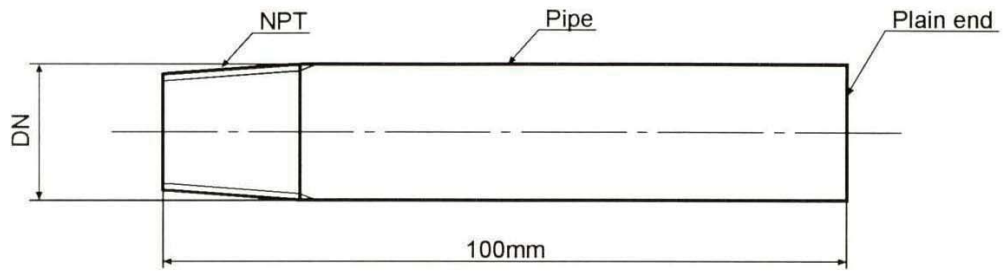
1.	STRAINER SIZE	BLOW OFF CONNECTION
	2" - 4"	3/4" NPT PLUG
	6" - 8"	1" NPT PLUG
	10"	1 1/4" NPT PLUG
	12" - 24"	1 1/2" NPT PLUG

 PROJECTS & DEVELOPMENT INDIA LTD	TFL-PDS-600	0
	DOCUMENT NO	REV

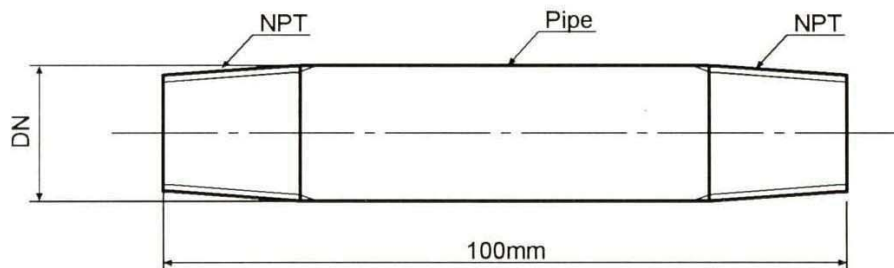
OTHER STANDARDS/DATASHEETS

NIPPLES

1) Half nipple (1/2-nipple)



2) Nipple

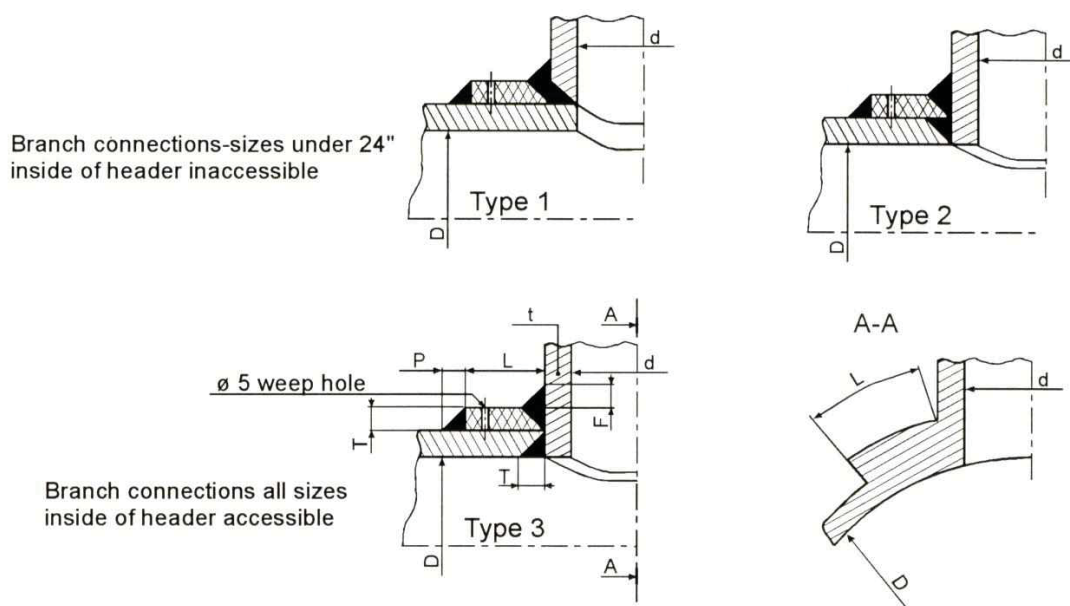


DN = 1/2", 3/4", 1" or 1 1/2"

Schedule and material of pipe acc. to piping class specification

Threading acc. to ANSI B 1.20.1-1983

REINFORCING RINGS



1. Reinforcing of branch connections shall be in accordance with limitations given in the General Piping Specification.

"Reinforcing rings" shall conform to the requirements of this specification.

2. All welds are to be continuous. Fillet welds to have concave contour.

3. Backchipping or gouging to sound metal before welding reverse side is required.

4. The periphery of the cut hole should be examined for laminations when using type 1.

5. Weld details for inclined nozzles are to be similar to the details shown for 90 degree nozzles.

6: The type must be determined by the fabricator.

Legend

T - Thickness of reinforcing ring, to be of the same thickness as header and of equal or better material. Preferably cut from header.

P - Fillet weld leg dimension, equal to T.

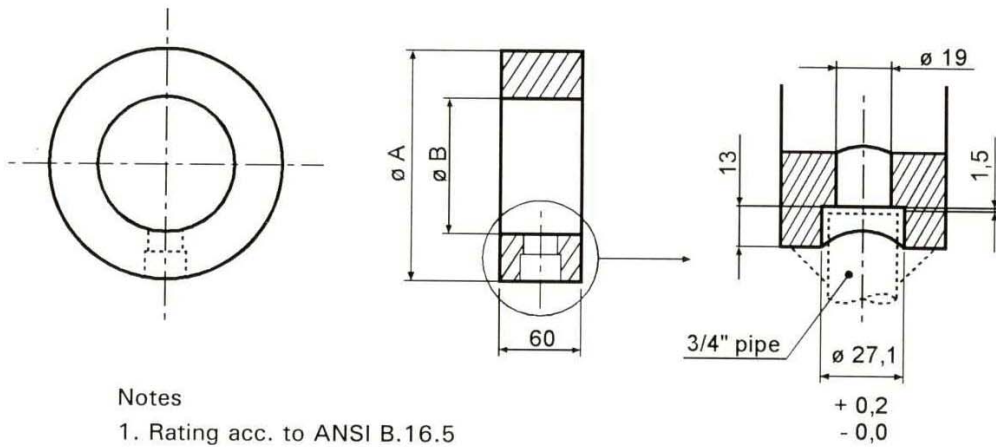
F - Fillet weld leg dimension equal to t.

L - Width of reinforcing ring, see table. For branch sizes > 36" L = d/2

Reinforcing ring table

Nom. Branch size "d" inch.	2"	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	24"	26"	28"	30"	32"	34"	36"
Ring width "L" mm	30	45	55	80	105	130	150	170	190	215	240	290	310	330	360	380	405	430

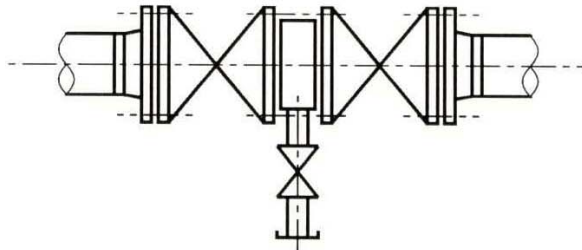
DRIP RING



Notes

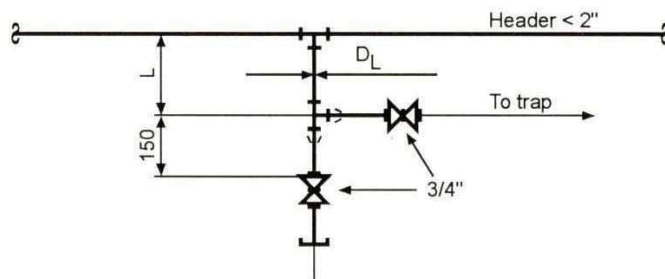
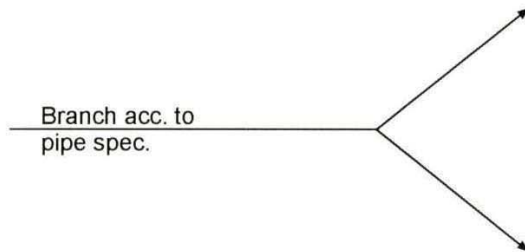
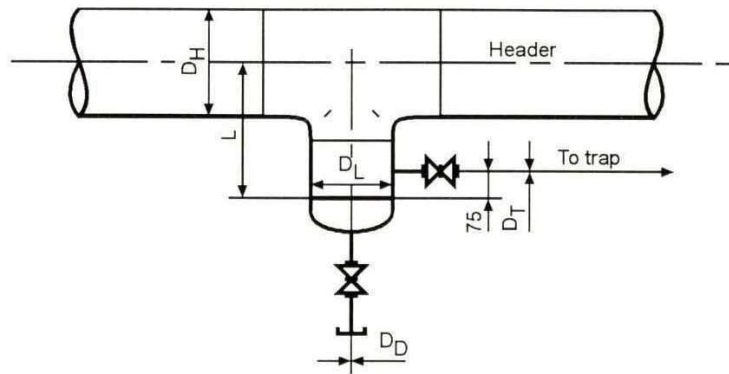
1. Rating acc. to ANSI B.16.5
2. Material in accordance with piping class
3. Faces to be machined parallel and finish to be in accordance with ANSI B.16.5
4. Nom. dia., rating and material to be engraved on edge in letters min. 5mm high e.g. 3"-CL. 600-A 182 Gr. F1

DN Inch.	Class 150 RF		Class 300 RF		Class 600 RF	
	A mm	B mm	A mm	B mm	A mm	B mm
2"	100	52	107	52	107	52
3"	132	78	145	78	145	78
4"	170	102	177	102	190	102
6"	220	154	247	154	263	154
8"	276	206	304	205	317	198
10"	336	260	358	254	396	247
12"	406	311	418	303	453	295
14"	447	343	480	334	487	317
16"	510	394	535	381	560	363
18"	545	445	592	429	608	409
20"	602	495	650	478	678	455
24"	713	590	770	575	786	547



Only where no alternative installation is possible, driprings shall be used.

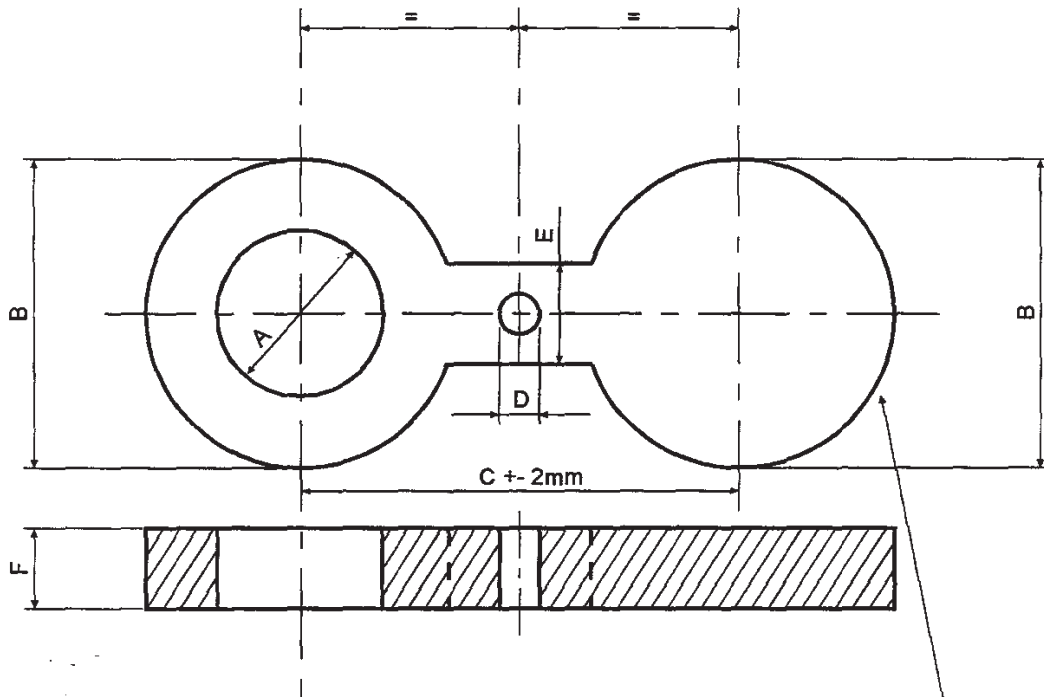
DRIP LEG ON STEAM HEADERS



*) D_L = Header size

D_H	= < 2"	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	24"
D_L	*)	3"	4"	6"	6"	8"	8"	10"	12"	12"	12"	12"
L	250	300	300	350	350	400	400	450	500	525	550	600
D_D	3/4"	3/4"	3/4"	1"	1"	1"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"
D_T	3/4"	3/4"	3/4"	3/4"	3/4"	3/4"	1"	1"	1"	1"	1"	1"

SPECTACLE PLATE CLASS 150 RF

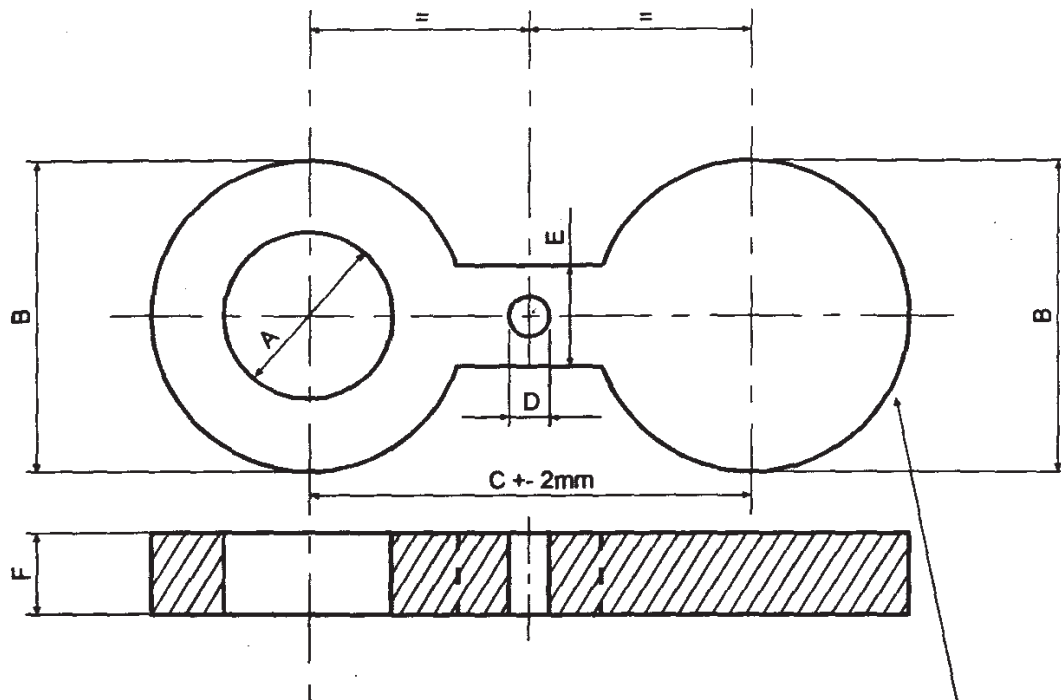


Spectacle plate suitable for flanges acc. to ANSI B16.5.
Material as for flanges acc. to piping class.

Norm. dia., rating and material to be engraved on edge in letters min. 5 mm high for example thus:
3"-class 150 -A105

Nominal diameter inches	Min. reqd. overlength bolt	A	B	C	D	E	F
1"	8	33	64	79	16	38	6
1 1/2"	8	48	83	99	16	38	6
2"	8	60	102	121	20	51	6
3"	8	89	133	152	20	64	6
4"	8	114	171	191	20	64	6
6"	12	168	218	241	22	76	10
8"	15	219	277	299	22	76	13
10"	18	273	337	362	26	102	16
12"	24	324	407	432	26	102	22
14"	27	356	447	476	30	108	25
16"	27	406	511	540	30	108	25
18"	27	457	546	578	33	114	25
20"	31	508	603	635	33	121	29
24"	37	610	714	749	36	140	35

SPECTACLE PLATE CLASS 300 RF

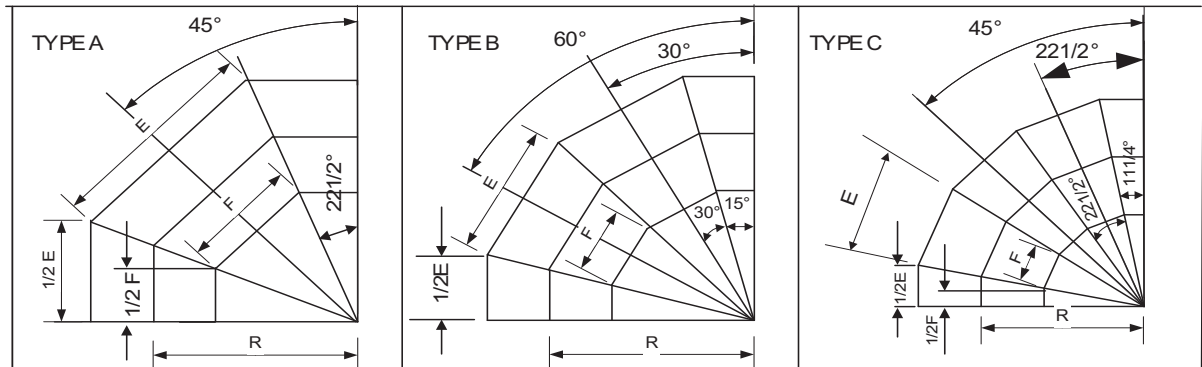


Spectacle plate suitable for flanges acc. to ANSI B16.5.
Material as for flanges acc. to piping class.

Nom. dia., rating and material to be engraved on edge in letters min. 5 mm high for example thus:
3"-class 300 -A105

Nominal diameter inches	Min. reqd. overlength bolt	A	B	C	D	E	F
1"	8	33	70	89	20	38	6
1 1/2"	8	48	92	114	22	51	6
2"	8	60	108	127	20	51	6
3"	12	89	146	168	22	64	10
4"	15	114	178	200	22	64	13
6"	18	168	248	270	22	76	16
8"	21	219	305	330	26	89	19
10"	27	273	358	387	30	102	25
12"	31	324	419	451	33	102	29
14"	34	356	482	514	33	121	32
16"	39	405	537	572	36	124	37
18"	43	457	594	629	36	114	41
20"	46	508	651	686	36	121	44
24"	56	610	772	813	42	140	54

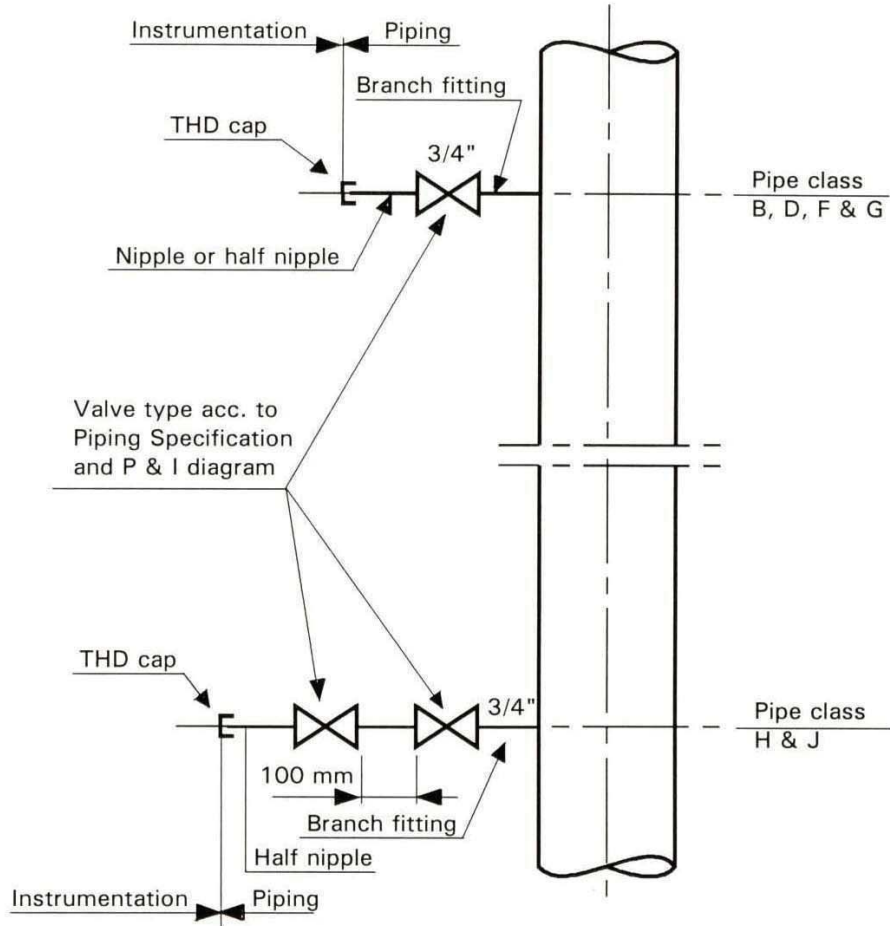
MITRE BENDS



NOM SIZE INCH	OUTSIDE DIAM D mm	R =1.5D mm	30° 60°	45°	90°	22 1/2°	DIMENSION					
							TYPE A		TYPE B		TYPE C	
							E mm	F mm	E mm	F mm	E mm	F mm
2	60.3	76	B	A	A	C	88	38	57	24	42	18
3	88.9	114	B	A	A	C	131	58	85	37	63	28
4	114.3	152	B	A	A	C	173	79	112	51	83	38
6	168.3	229	B	A	A	C	259	120	168	78	125	58
8	219.1	305	B	A	B	C	343	162	222	105	165	78
10	273.1	381	B	A	B	C	429	203	277	131	206	97
12	323.9	457	B	A	B	C	513	244	332	158	246	117
14	355.6	533	B	C	B	C			381	190	283	141
16	406.4	610	B	C	B	C			436	218	323	162
18	457	686	B	C	B	C			490	245	364	182
20	508	762	B	C	B	C			544	272	404	202
22	559	838	B	C	B	C			599	300	445	222
24	610	914	B	C	B	C			654	327	485	243
26	660	991	B	C	C	C			707	354	525	263
28	711	1,067	B	C	C	C			762	381	566	283
30	762	1,143	B	C	C	C			817	408	606	303
32	813	1,219	B	C	C	C			871	436	647	323
34	864	1,295	B	C	C	C			926	463	687	344
36	914	1,372	B	C	C	C			980	490	727	364
38	965	1,448	B	C	C	C			1,034	517	768	384
40	1,016	1,524	B	C	C	C			1,089	544	808	404
42	1,067	1,600	B	C	C	C			1,144	572	849	424
44	1,118	1,677	B	C	C	C			1,198	599	890	445
46	1,168	1,752	B	C	C	C			1,252	626	929	465
48	1,219	1,829	B	C	C	C			1,307	653	970	485
52	1,321	1,982	B	C	C	C			1,416	708	1,051	526
56	1,422	2,134	B	C	C	C			1,524	762	1,131	566
60	1,524	2,286	B	C	C	C			1,633	817	1,213	606
64	1,626	2,439	B	C	C	C			1,743	871	1,294	647
68	1,727	2,591	B	C	C	C			1,851	925	1,374	687
72	1,829	2,743	B	C	C	C			1,960	980	1,455	728
76	1,931	2,897	B	C	C	C			-	-	1536	768

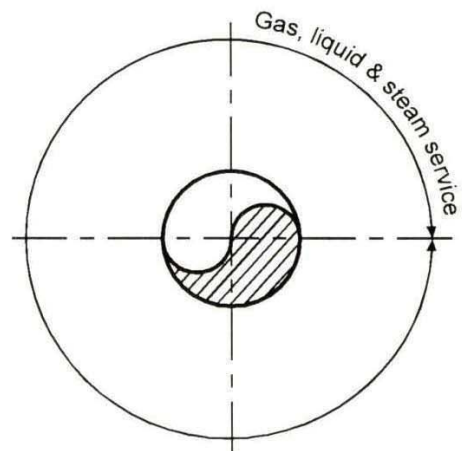
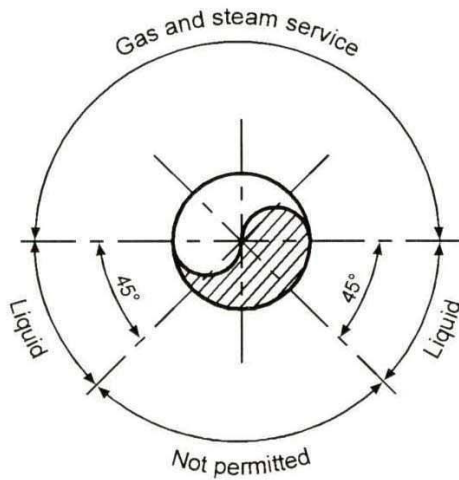
P1	27.12.2017		FOR REVIEW/COMMENT	NAZ	NS	GL/HOD
P	21.10.2017		FOR REVIEW/COMMENT	NAZ	NS	DM
REV	REV DATE	EFFDATE	PURPOSE	PREPD	REVWD	APPD

BRANCH FOR ANALYSIS - AND PRESSURE CONNECTIONS ON PIPING
 (FOR ANALYSIS CONNECTIONS WITH PROBE SEE SPECIAL DRAWINGS)



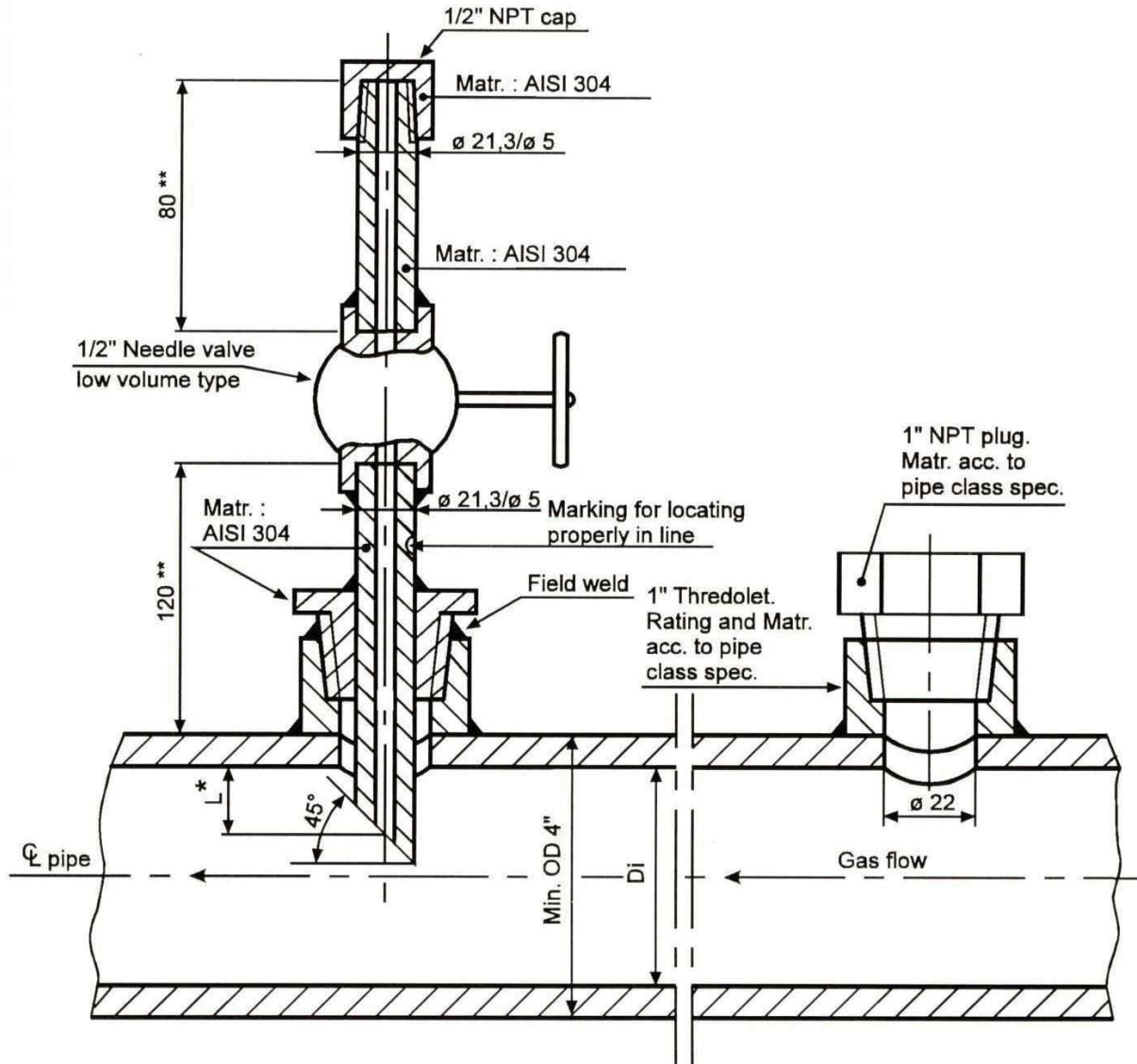
Location of branch in horizontal line

Location of branch in vertical line



All branch fittings and valves to be specified acc. to pipe class.

**ANALYSIS CONNECTION WITH PROBE ON PIPE
FOR RATINGS <= CLASS 900**

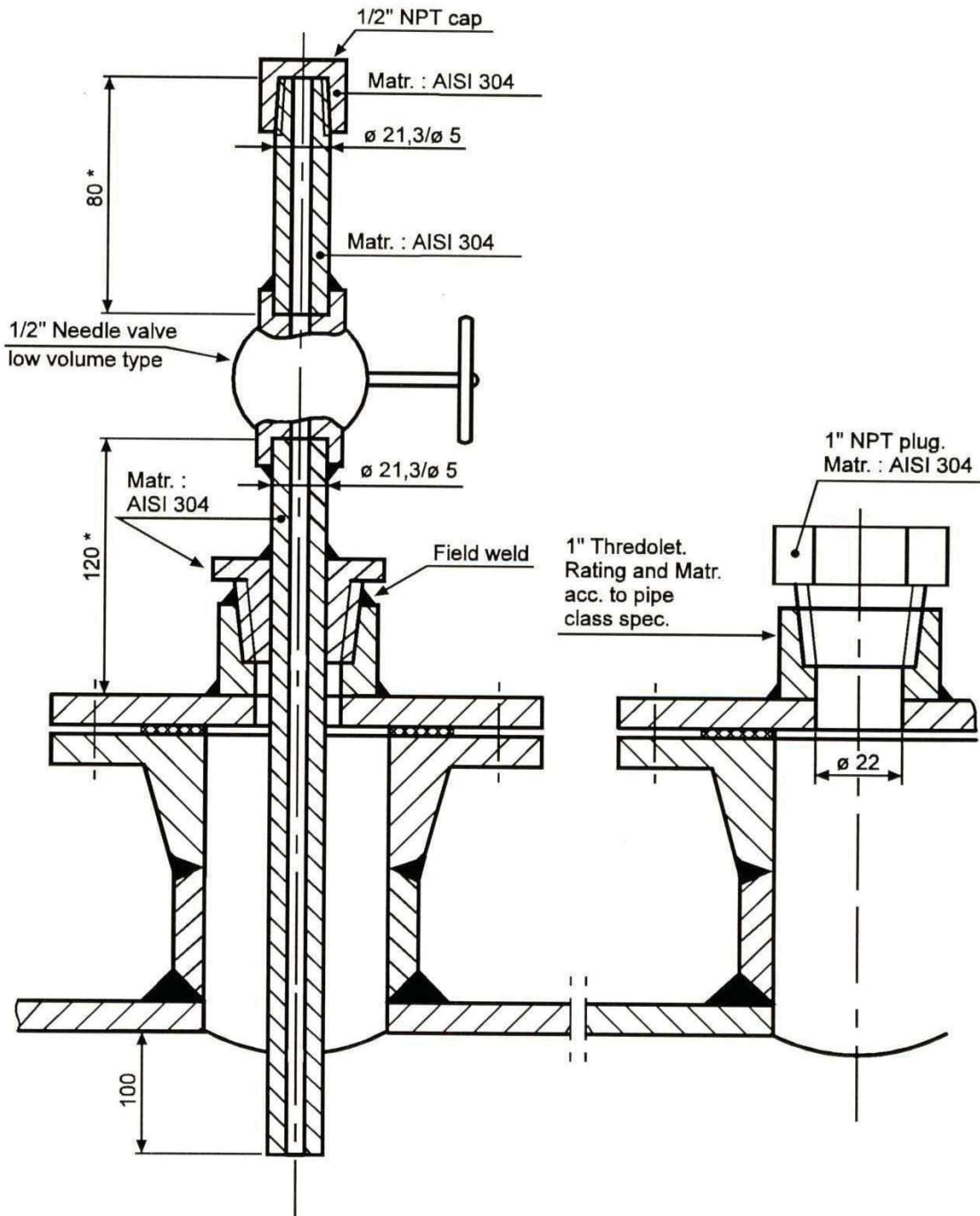


**Final execution
Instrumentation supply**

**During pressure test and cleaning
Piping supply**

- * For $D_i > 6"$, $L = 1/3 D_i \pm 1/6 D_i$
For $D_i \leq 6"$, $L = 1/2 D_i \pm 1/6 D_i$
- ** Shortest possible

**ANALYSIS CONNECTION WITH PROBE ON EQUIPMENT
FOR RATINGS <= CLASS 900**

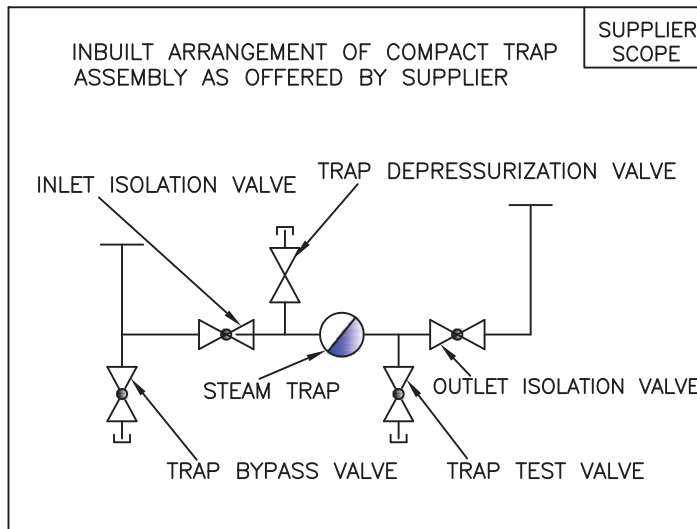
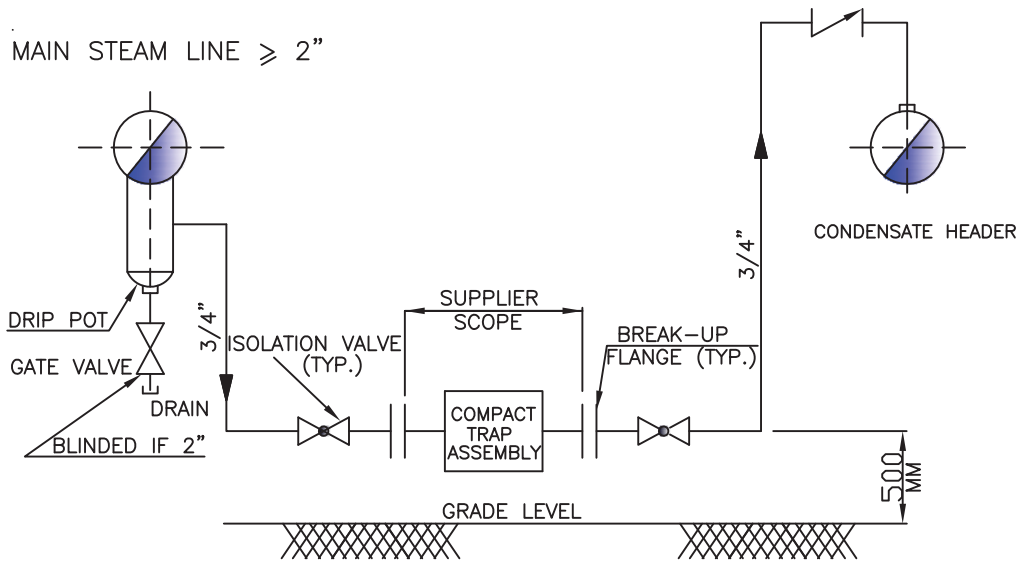


**Final execution
Instrumentation supply**

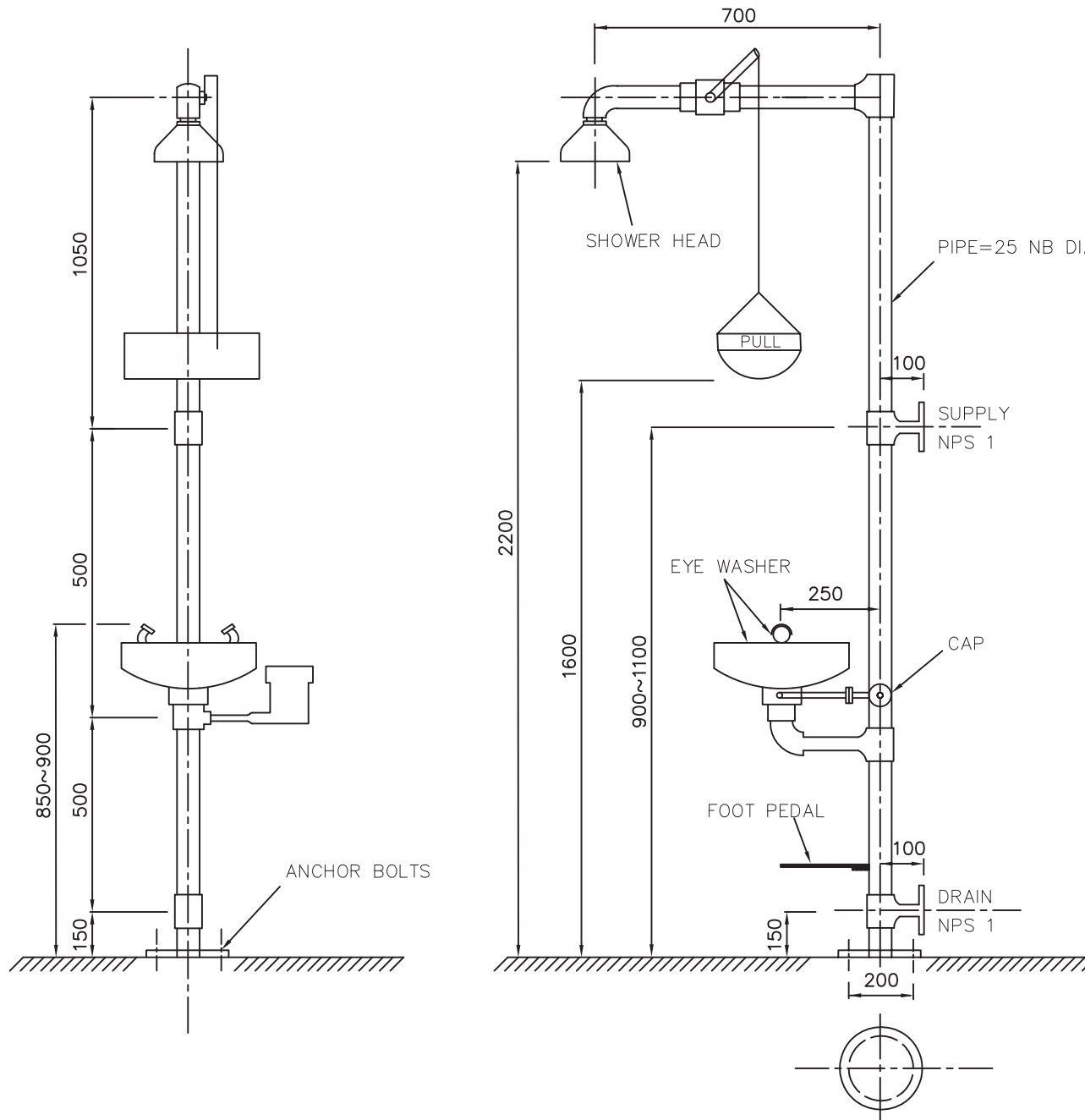
**During pressure
test and cleaning
Piping supply**

* Shortest possible

TYPICAL ARRANGEMENT OF DRAIN FOR STEAM LINES AND STEAM TRAP



DATASHEET FOR SAFETY SHOWER AND EYE WASH UNIT (COMBINED)



SUPPLY WATER CONDITIONS

- | | |
|-----------------------|---------------------------|
| 1) SUPPLY WATER | : POTABLE WATER |
| 2) DESIGN PRESS. | : 7 kg/cm ² g |
| 3) DESIGN TEMP. | : 70 °C |
| 4) HYDRO. TEST PRESS. | : 1.5 times of Design Pr. |
| 5) MINIMUM FLOW. | |
| a) SAFETY SHOWER | : 110 Lit/min. |
| b) EYE WASH | : 12 Lit/min. |

MATERIAL

- | | |
|---------------------|------------|
| 1) PIPE | : SS304 |
| 2) FITTING | : SS304 |
| 3) FLANGE | : SS304 |
| 4) VALVES/STRAINER | : SS304 |
| 5) BOWL FOR EYEWASH | : SS304 |
| 6) EYE WASH NOZZLE | : SS304 |
| 7) SHOWER HEAD | : SS304 |
| 8) PULL CHAIN | : SS304 |
| 9) FOOT PEDAL | : SS304 |
| 10) SPRING | : SS304 |
| CODE/STANDARD | : IS 10592 |

NOTES:

- 1) THE GIVEN DIMENSIONS ARE ONLY FOR REFERENCE; THE MANUFACTURER'S STANDARD DIMENSIONS MAY BE APPLIED, SUBJECT TO APPROVAL .
- 2) THE COMBINED UNIT OF SAFETY SHOWER & EYE WASH SHALL BE PULL ROD AND FOOT PEDAL OPERATED AND PROVIDED WITH DUST COVER & FILTER.
- 3) ALL SAFETY SHOWER & EYE WASH UNIT SHALL BE PAINTED WITH FLOURESCENT PAINT SO THAT IT CAN BE VISIBLE IN NIGHT. NAME PLATE TO BE PROVIDED ON EACH SAFETY SHOWER & EYE WASH UNIT.
- 4) SAFETY SHOWER & EYE WASH UNIT SHOULD BE ISI MARKED.
- 5) THE COMBINED UNIT OF SAFETY & EYE WASH SHOULD BE CAPABLE TO PROVIDE A CUIPOUS FLOW OF WATER FOR ATLEAST 15 MINUTES.
- 6) ALL DIMENSIONS ARE IN MILLIMETERS.
- 7) OTHER SIZES BY VENDOR.
- 8) The spray nozzles shall be so designed as to deliver a spray of rinse water without harsh jets or misting. The water cone shall have vortex angle of 45°.

 PROJECTS & DEVELOPMENT INDIA LIMITED	PC0183/4018/Sec VI/3.1.5	0	
	Document No.	Rev	
	Sheet 1 of 17		

SECTION – VI 3.1.5

DESIGN SPECIFICATION – FIRE FIGHTING SYSTEM

COAL/PETCOKE/LIMESTONE HANDLING FROM RAILWAY SIDING TO STORAGE YARD



**PROJECT: INTEGRATED COAL BASED FERTILISER
COMPLEX AT TALCHER, ANGUL DISTRICT,
ODISHA (INDIA)**

TABLE OF CONTENTS

CLAUSE NO.	DESCRIPTION
1.0	PURPOSE
2.0	DEFINITIONS
3.0	SCOPE
4.0	SPECIFICATIONS FOR FIRE PROTECTION SYSTEM.
5.0	FIRE WATER DISTRIBUTION SYSTEM.
6.0	FIRE WATER SYSTEM.
7.0	TECHNICAL REQUIREMENTS
8.0	PIPING SYSTEM AND VALVES
9.0	SAFETY EQUIPMENTS
10.0	SAFETY IN SYSTEM DESIGN
11.0	EXECUTION, INSPECTION AND TESTING
12.0	DOCUMENTATION
Annexure-1	DETECTION, ACTUATION, ALARM AND COMMUNICATION SYSTEM

LIST OF ATTACHMENTS

ATTACHMENT NUMBER	DESCRIPTION	NUMBER OF SHEETS
PC183-PNMP-TS-PPE	TECHNICAL SPECIFICATION OF PERSONNEL PROTECTIVE EQUIPMENT	-

	COAL/PETCOKE/LIMESTONE HANDLING FROM RAILWAY SIDING TO STORAGE YARD TALCHER FERTILIZER PLANT, ODISHA DESIGN SPECIFICATION- FIRE FIGHTING	PC0183/4018/Sec VI/3.1.5	0	
		Document No.	Rev	
		Sheet 3 of 17		

1.0 PURPOSE



The purpose of this document is to establish the design basis of the complete fire fighting system.

2.0 DEFINITIONS

- Owner - Talcher Fertilizers Ltd. (TFL)
- LSTK - Lump Sum Turn Key Contractor
- CCE - Chief Controller of Explosives
- NFPA - National Fire Protection Association
- IS - Indian Standards
- TAC- Tariff Advisory Committee

3.0 SCOPE

- 3.1 This specification covers design basis and execution requirements for fire protection system as per statutory regulations /NFPA codes/TAC/NBC to be provided by contractor. The design and construction of the fire detection and protection equipment shall be of internationally accepted standards and in compliance with the regulations of the Tariff Advisory Committee (TAC) and other relevant statutory requirements for Coal/Petcoke/Limestone Handling. Any other Standard which are not mentioned in the technical specification but are found necessary to meet the requirement of TAC and also for safe and sound operation of the plant are to be included at no extra cost to the Owner.
- 3.2 The CONTRACTOR shall design, supply and erect complete fire fighting network / system inside and around the plant.
- 3.3 The Bidder shall confirm that the fire fighting system is complete with all facilities whether specified in this specification or not.
- 3.4 A comprehensive fire detection and alarm system and fire protection system shall be designed for the whole of the proposed Coal/Petcoke/Limestone Handling facility to provide a high degree of protection for plant, equipment and buildings and employees. Interfacing with other systems (e.g. fuel and air handling plants, ventilation systems, etc.) will be required.
- 3.5 Taping/s with the fire water mains provided at plant battery limit (adjacent to the proposed location) shall be provided as per requirement. The same (tie-in location/s) shall be decided during the detail engineering.
- 3.6 The CONTRACTOR'S design and engineering activities listed in this specification are the minimum requirements to be complied with preparation of detailed design basis, specifications, standards and list of codes for each system based on guidelines given in subsequent clauses of scope of work.
- 3.7 The term 'Fire Fighting System' referred here generally covers various equipments and facilities being provided for controlling fires. These include facilities such as fire water network accessories and fire detection & control system, fire water piping network together with hydrants, monitors, detectors/alarms, various kinds of portable fire extinguishers like Dry Chemical Powder type, etc., as well as sand and water buckets and sign boards.
- 3.8 The Fire Fighting System shall be designed to provide adequate facilities for extinguishing any fire in the entire area of Coal/Petcoke/Limestone Handling facility and associated facilities of the proposed Scope of work. The system shall be designed and installed as per TAC / NFPA/ API/ IS standards and also as per latest applicable standards/ codes. The system shall be

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complete in all respects essential for proper installation operation and maintenance, irrespective of whether such systems are specifically mentioned in this specification or not.

- 3.9 Hydraulic analysis of fire water ring main network including line size, flow and pressure at various section of the system shall be submitted for Owner/Consultant's approval.
- 3.10 The detail design shall take into consideration of all stipulations, practices followed by Statutory Regulations/Authorities for all types of jobs of this package.
- 3.11 Preparation of PFD/ P&ID's and equipment data sheets. Preparation of material take-off, material requisitions and purchase requisition of bought out items. Design calculations for the respective fire protection system. Installation drawings and documents. Operating maintenance and spare parts manuals wherever applicable.
- 3.12 Taking approval from statutory authorities.
- 3.13 The following latest Codes and Standards shall be followed.

S. No.	Stds No.	Title
1	NFPA-1	Uniform Fire Prevention Code
2	NFPA-10	Portable Fire Extinguishers
3	NFPA-11	Low Expansion Foam and Combined agent Systems
4	NFPA-12	Carbon dioxide extinguishing Systems
5	NFPA-12A	Halon 1301 Fire Extinguishing Systems
6	NFPA-13	Installation of Sprinkler Systems
7	NFPA-14	Installation of Stand Pipe & Hose Systems
8	NFPA-15	Water Spray Fixed System for Fire Protection
9	NFPA-16	Installation of deluge foam-water sprinkler and foam water spray systems.
10	NFPA-17	Dry chemical extinguishing systems.
11	NFPA-17A	Wet Chemical Extinguishing Systems
12	NFPA-70	National electric code.
13	NFPA-72	National Fire Alarm Code
14	NFPA-77	Recommended Practice on Static Elect.
15	NFPA-2001	Clean Agent Fire Extinguishing Systems
16	NBC	National Building Code
17	IS 3844	Installation and maintenance of internal fire hydrants and hose reels on premises National Building Code 2016 (and/or Latest)

Also Contractor shall follow the following manuals/ references for fire fighting system:

- ❖ Fire Protection Manual (Internal Appliances, Fire Engines, Trailer Pumps and Hydrant Systems) issued by Tariff Advisory Committee.
- ❖ Rules of Water Spray System
- ❖ Rules for Automatic Sprinkler Installations

- 3.14 All equipment in the entire fire protection & detection system shall have the approval from any one or more of the followings:
- a) UL of USA
 - b) LPCB-UK
 - c) BIS-India
 - d) FM-USA
 - e) VDS- Germany

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However, the design and installation of complete system and requirement shall be approved by statutory authorities.

4.0 SPECIFICATION FOR FIRE PROTECTION SYSTEM

4.1 System Requirement

The fire protection System is required to ensure protection of the facility in order to combat an outbreak of fire so as to reduce damage and consequential losses. The fire Protection system includes fire detection, containment and suppression system. The Proposed fire protection system will be designed to provide adequate safety measures in the areas susceptible to fire in the Coal/Petcoke/Limestone Handling facility in compliance with the recommendations of the Tariff Advisory Committee (TAC) / National Building Code (NBC) 2016. The entire Fire fighting system will have a centralised panel housing required for the Electrical, mimic of the system and will be hard wired to the centralized DCS to show the Mimic and provide alarms.


The Indicative Area wise requirement of fire detection and protection system will be as given below.

Sr. No.	Area	Type of detection	Type of Protection
1.	Transformer above 5 MVA in Transformer yard.	Quartzoid Bulb detector	Automatic High Velocity Water Spray System.
2.	Cable Vault in Electrical control Building	Ionisation type smoke Detector.	Portable Fire Extinguisher.
3.	Control Room	Addressable smoke detector of Ionisation & Photoelectric type.	Clean Agent System.
4.	Switchgear room, MCC Rooms in Control / Electrical Building	Addressable smoke detector of Ionisation & Photoelectric type.	Clean Agent System.
5.	Battery/UPS Room	Suitable Smoke/Heat/H2 detector with alarm in control room	Clean Agent System.
6.	Electrical Rooms in Various Plant Buildings.	Suitable Smoke/Heat detector with alarm in control room	Portable type Fire Extinguisher.
7.	Sub Station	Addressable smoke detector of Ionisation & Photoelectric type.	Water Spray system at cable cellars. (Carbon dioxide gas flooding fire extinguishing system for Electrical panels at substations)

Apart from the above station building, transformer yard, boiler area, pumps, compressor and fuel handling plant will be protected with hydrant system.

Following types of Fire Protection system shall be provided.

- i) Hydrant System.
- ii) Automatic High and Medium Velocity Water Spray Systems.

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- iii) Automatic Fixed Foam system for Fuel Oil storage Tanks.
- iv) Automatic inert Gas system.
- v) Portable and Mobile Fire Extinguishers.
- vi) Automatic CO2 Fire Fighting system.
- vii) Jets/portable curtains/DCP/special DCP etc.

5.0 FIRE WATER DISTRIBUTION SYSTEM

5.1 General



- i) Fire water ring header shall be extended to all the process plants and storage areas. Material for fire water piping shall be outer wrapping/coating carbon steel with cathodic protection for underground piping and carbon steel for aboveground piping.
- ii) Underground fire hydrant ring main facility, with strategically placed hydrant connections, shall be provided to suit the site/ plant/ building configuration. Underground piping shall be below ground with minimum 1 m earth cushion.
- iii) Indoors hydrants for plant and non-plant buildings shall be provided as required.
- iv) Hydrants shall be spaced at 30 m for high hazard occupancies, at 45 m for moderate/ordinary hazard occupancies.
- v) Fixed Water Spray Systems (Sprinkler / High Velocity Spray Water / Medium Velocity Spray Water) shall also be considered for establishing the conformity of fire protection system.
- vi) For process units, external ring header with hydrants and an internal distribution with monitors and hose reels shall be installed.
- vii) Along the network, a number of block valves shall be located in such a way that the various areas of the plant can be fed with fire water even during maintenance operations on part of the fire water network.
- viii) Fire water pressure at the farthest point shall be a minimum of 7 Kg/cm² after installation of headers and sub headers.
- ix) F.W. header / line shall be laid in RCC trench on pedestal supports with sand filled and covered with pre-cast slab. Cathodic protection also to be considered for underground / trenched piping.
- x) Fire water shall not be used for any other purpose.
- xi) Outdoor hydrants shall be one hydrant post with two hydrant valves.

6.0 FIRE WATER SYSTEM

Fire Water System shall be designed as per TAC guidelines / NFPA Code and complied with Local Law/ Civil Defence requirements.

6.1 Fire Fighting System

- a) Fire Hydrant shall be provided in a ring round the Coal / Petcoke / Limestone Handling facility in the scope of work.
- b) Fire Fighting System design and layout is subject to review and approval by Local Authorities.

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- c) Contractor shall calculate the fire water requirement for their scope and tie-in for scope shall be taken from the OSBL fire water network. Offsite fire water network (OSBL scope) shall be available around the unit. Contractor shall take each tapping from Offsite header with an isolation valve.
- d) Valves on fire water mains shall be of Gate type only. Valves on fire water lines shall be located in RCC valve chamber provided with top cover to facilitate easy operation/maintenance of valves. The top of chamber shall be minimum 80 mm above ground level.
- e) The bidder shall identify the fire risks for the proposed plant and provide appropriate fire protection equipment accordingly. It is expected that these will include (but not necessarily be limited to) the following:
- i) All conveyors, terminal buildings, wagon tippler, track hopper tunnel with shade
 - ii) Transfer Tower systems
 - iii) Oil filled transformers
 - iv) Records / library rooms
 - v) Control rooms
 - vi) Cables, Electrical Bays (switch gear room, MCC room, sub station, cable cellar/ cable spreader room etc.)
 - vii) Diesel engines and fuel tanks
 - viii) All other indoor and outdoor stores where any inflammable substance may be present
 - ix) All Buildings including pump house, compressor house, equipments coming under scope of Contractor's Battery Limit.
- f) Indoors hydrants with hydrant valves (landing valves), hose reels and hose box containing accessories, for plant buildings and non-plant buildings, shall be provided as per IS-3844. In case of buildings, hydrants shall be located at not be less than 2 m and not more than 15 m from the face of building.

7.0 Technical Requirements

7.1 Hydrant System


Pressurized fire hydrant system will consist of a pipe network and hydrants positioned around the station in sufficient numbers and so located that all buildings and risks are readily protected. Necessary number of loops will be formed around various risks.

The loops will be interconnected for better reliability of the system. To isolate a portion of the ring main because of damage/repair, suitable nos. of valves will be provided.

The hydrant network will be sized and analysed to ensure that about 7.0 Kg/cm² pressure is available at the hydraulically remotest point in the system with the hydrant pump discharging at rated head and capacity. The velocity in the hydrant main will not exceed 3 m/sec.

Hose pipes of suitable lengths along with standard accessories like branch pipes, nozzles, spanners, etc. will be provided. These will be kept in a central hose house for the outdoor hydrants. Each internal hydrant valve will be provided with individual hose box having glass front containing hose pipes, hose reel, branch pipes and nozzles etc.


- a) The general design of hydrants valve shall conform to IS:5290 type A and material of construction shall be stainless steel (SS-304).

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- b) The general arrangement stand post assembly, consisting of a column pipe and a hydrant valve with a quick coupling end shall be as per requirement of TAC with respect to outdoor and indoor operation suitability.
- c) Material of construction for Branch pipes shall be Stainless steel (SS-304) and it shall have rings at both the ends. One end of the branch pipe will receive the quick coupling while the nozzle will be fixed to the other end.
- d) The general design and construction of instantaneous couplings, branch pipes and Nozzles shall be as per IS: 903 (latest edition). Metal couplings at both ends of hose pipes shall be of SS 304.
- e) 2 Nos. 15m long RRL type Hose pipe 63 mm size conforming to IS: 636, fitted with quick coupling ends, branch pipes, nozzles, spanner etc. shall be kept in a hose box, which shall be located near point of use.
- f) Hose boxes shall be made of M.S. material and painted red with dimensions 18 SWG thick M.S. sheet, size 900 mm x 600 mm x 250 mm. Each box shall contain 2 nos.x 15 m of 21/2" fire hose (IS-636 Type-B) with gun metal nozzle, coupling, universal branch pipe (IS-903), MS spanner. 1no. Hose Box with accessories shall be provided for each hydrant post and each fire brigade connection (3 Way, 4 Way with isolation gate valve).
- g) Fire Water Monitors shall be provided when height of the structure, tower exceeds 15 mtr and the same shall be as per IS:8442.
- h) There may be cases where due to horizontal obstruction, a particular vessel/ process column may not be approachable by ordinary monitor or hydrant, elevated long range monitors shall be provided to take care of such conditions.
- i) Fire hose reels shall be considered at strategic locations around block as first aid fire contingency. These shall be floor mounted type and shall have water connection from hydrant network. Each hose reel shall have 30 meter long hose with nozzle. Hose reel shall be located as per Std. (IS 884) and should cover all process areas in ground floor. Additional hose reels shall be provided with each landing valve. Hose reel shall be 30m x 20mm bore.

7.1.1 Fire water network

- a) Fire water network shall consist of mostly aboveground and/or underground, if required, piping systems.
- b) Around units the fire water mains shall be laid aboveground and directly buried and/or in trenches, if it is laid underground. The underground ring main network system shall be laid at minimum one meter earth cushion. Top of casing pipe (RCC Hume pipe) of underground piping crossing roads (peripheral road, package unit road, access road/ways) shall be at min. 1.5 metre depth.
- c) All underground fire water piping shall be externally protected from corrosion by wrapping and coating of cold tape as per attached specification, for underground CS pipe which shall extend up to min. 500 mm, above / beyond grade wherever applicable.
- d) Above ground fire water piping shall be painted as per painting specification and the paint shall be conforming to shade as per IS 5.
- e) Wherever fire water line will cross the roads, same shall be put under a suitable hume pipe or culvert, with proper wrapping, coating as a anticorrosive treatment (Cold Tape Type, as per detailed specification provided elsewhere in NIT).
- f) Flushing point with isolation gate valve and pressure gauge points (approx at the rate 300mtr. and at all battery limit tie in points) with isolation gate valve shall be provided on all headers.

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- g) Network shall be laid in closed loops to ensure multidirectional flow. Isolation valve to be provided at every 300m (max) and at crossings (Junctions) to ensure easy maintenance and uninterrupted water supply in case of break down and shall be planned in such a way that outage of any section of fire water line should not affect other section.
- h) Hydrant posts shall be installed with a branch "L" shape piping to avoid directly fall of leaking water on main header.
- i) RCC slabs (Minimum 1500mmX1500mmX100mm thk.) shall be provided at the grade level beneath of each Hydrant/Monitor/HVLR post and respective hose box.
- j) Up to 2.0 m portions of the headers (if above ground) on both sides of hydrant branching and the entire branch piping near of hydrants shall be epoxy painted.
- k) Isolation valves (gate valves, rising spindle) shall be provided below monitors and at all hydrants. Suitable restriction orifice shall be provided at downstream of isolation valve of hydrant post to maintain the pressure requirements as per TAC / IS15394.
- l) Fire water pressure at the farthest point shall be a minimum of 7 kg/cm² after installation of headers and sub headers.
- m) All fire water piping shall be tested to hydraulic test pressure of 18 kg/ cm² (g) and/or as calculated considering pump shut-off pressure.
- n) Radiography requirements shall be as per TAC (minimum 10%).
- o) For process units, external ring header with hydrants and an internal distribution with monitors and hose reels shall be installed. Hydrant heads shall be placed at a minimum distance of 15m from process equipment.
- p) Monitors around heater areas, if any, shall be necessarily provided and located in such a manner that the heater can be isolated from the plant.
- q) Monitors shall be provided to cover the high rise columns, equipments etc. of height 15 mtr. and above, unless otherwise specified in layout drawing.
- r) There may be cases where due to horizontal obstruction, a particular vessel/ process column may not be approachable by ordinary monitor or hydrant, elevated monitors shall be provided to take care of such conditions.
- s) Tall columns, structure, towers and equipment where it may not be possible to provide access staircases with hydrants on landing, will be considered as protected by hydrants at ground level, provided they are less than 15 m in height. When the height exceeds 15 m, the concerned hydrants shall be replaced by monitors.
- t) Alternate hydrants for protection of loading unloading bays, rail/truck gantries shall be replaced by water/foam monitors.
- u) Number of hydrants shall be based on one hydrant post with two hydrant valves for every 30m (max.) of external perimeter of process units and storage tank area. For utility and other building areas, this distance shall be a maximum of 45m.
- v) Hydrants and/or water monitors shall be located keeping in view the different risks within the premises which are to be protected and ensuring effective coverage.
- w) Double hydrants (IS: 5290 type A, hydrant valve with single outlet) on each hydrant post (i.e. two hydrant valves mounted on each stand post) and at every 30m centre to centre, along the hydrant mains, shall be provided.
- x) Extension of hydrants/monitors for spill fire (as required by TAC/ IS15394) shall also to be provided.
- y) Indoors hydrants with hydrant valves (landing valves), hose reels and hose box containing accessories, for plant buildings and non-plant buildings, shall be provided as per IS-3844. In case of buildings, hydrants shall be located at not be less than 2 m and not more than 15 m from the face of building.
- z) Double headed landing valves (two numbers, type-A, Landing valves on single stand post), shall be provided on the landing of first floor and above on all the buildings/Tech structure/platforms etc. with isolation valve at each tapping for landing valve assembly.

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The monitors shall have isolation valve. Monitor location shall be given special consideration for protection of cluster of towers, heaters and other high structures, where it may not be possible to approach the higher levels. Minimum of two monitors shall be provided for each such area.

Field adjustable variables flow type remote operated monitors shall be provided for the protection of inaccessible equipment.

Contractor to finalise hydrant layout on plot plan, with all the requirements such as number of Hydrants, Monitors, Foam system, sprinkler system etc., based on all statutory requirements & Code Guidelines, considering ease of maintenance and safe approach for fire fighting. Due consideration is to be given for providing Emergency escape routes also. Hydrants are to be strategically located to obtain maximum advantage of layout.

Fire brigade connection (3 way & 4 way) points with Isolation gate valve as per TAC/ IS shall be provided at strategic locations

Above ground pipe shall be supported on RCC pedestals (refer attached drawing). wrapper plate (thickness same as pipe & covering approx. 120 degree at bottom portion of pipe) shall be provided at each support for above ground pipe (6" NB and above). Supports for piping system and structures shall be provided as per support specifications of NIT. If support specification not provided in NIT, safe adequacy calculations shall be submitted by bidder for review/approval by PMC/owner.

7.1.2 Buried Pipes



The following points to be considered in designing of buried pipes

- i) All underground buried metallic piping shall be coated and wrapped with cold tape and laid at minimum one meter earth cushion.
- ii) Underground pipe at crossing roads, access ways shall have RCC casing pipe (Culvert or Hume pipe). Underground piping at rail crossing shall be as per Indian railways.
- iii) Valve chamber wherever required shall be made of brick or concrete. Valve chamber should be spacious to attend valves during operation/maintenance.
- iv) All U.G. headers shall clear equipment foundations.
- v) Provide break flange at + 500 MM from floor level to isolate underground pipe from above ground piping with insulating gasket kit.
- vi) Pipes shall be laid below electrical cables, if any.
- vii) Buried Pipes shall be laid in trenches after excavation, covered with 150mm sand bed all around them, backfilled and properly rammed.
- viii) RCC thrust blocks shall be provided as per engineering requirement.
- ix) Cathodic protection shall be provided for buried pipes.

7.1.3 Piping in Trenches

The following points to be considered in designing of trench pipes:

- i) Piping located below grade, requiring inspection, servicing or provided with protective heating.
- ii) Fire water lines/Process lines.
- iii) Drain lines requiring gravity flow trenches.
- iv) Sump for valves and trenches shall be provided.
- v) Suitable draining scheme for trenches shall be provided.
- vi) Valves in trenches shall be provided with extended stems. If hand wheels of the valves are located more than 300 mm below the cover plate, the valves shall be provided with extended stems extending to within 100 mm below the cover plate.

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- vii) The trenches shall be lined with RCC, then provided with 150mm sand bed and also shall be covered with RCC cover after laying of wrapped and coated pipes in them. Top of pipe shall be at minimum one meter depth.
- viii) RCC thrust blocks shall be provided as per engineering requirement.

7.1.4 HYDRANT SYSTEM PIPING MATERIAL

- Materials & equipments used for fire protection system shall be in accordance with NFPA/TAC requirements and/or attached specifications of NIT.
- Pipes (API 5L Gr.B, SMLS upto 6"NPS and welded for higher sizes) fittings (ANSI/ASME), valves (API/ASME), flanges(ANSI/ASME), Spray nozzles and deluge valves, quartzoid bulb detectors (QBD), Detector piping, Hydrant, Monitors, Hose Boxes, Hoses shall be as per piping material specifications (PMS), and/or attached specifications of NIT.
- Cast Iron valves or any cast iron piping component like pipes, fittings, flanges, valves, fasteners, gaskets, etc. shall not be used for fire fighting system or for any service.
- Spiral welded pipes shall not be used.
- Seamless pipes/fittings are acceptable in lieu of welded pipes/fittings, but welded pipes/fittings are not acceptable in lieu of seamless pipes/fittings.
- LSAW pipes are acceptable in place of ERW pipes, for same thickness.
- Double seam , 180 degree apart , is allowed for pipe sizes 36" and larger only.
- Circumferential seams (minimum 2 meter apart) is allowed for pipe sizes 36" and larger only.
- Flanges shall be in one piece material, without any joints.
- All flanged valves (except forged) shall have flanges integral with the valve body.
- Forgings are acceptable in place of castings but not vice-versa.
- Valves in saline water (if applicable) service shall be with non ferrous trims and all wetted parts other than trims shall be epoxy coated.
- Generic material of valves body, required as per process/service conditions but not specifically mentioned, shall not be lower in chemical composition than the connecting pipe material.
- PN equivalent rating for Class150# valves shall be minimum PN16.

7.2 Water Spray System


Water spray systems provided shall meet the requirements of NFPA /TAC, and job specifications. The rate of water applications and mode of operation shall be as per TAC/Standards. Low point drains shall be provided in the water spray network.

Linear heat sensing device shall be provided for all floating roof tanks, if applicable.

Automatic fixed water spray system shall be provided for the cable cellars of Sub-station and the oil filled transformers and Diesel/LDO/Fuel Oil Tank. The system shall be designed in accordance with NFPA 15/TAC.

Medium velocity Water Spray (MVWS) System to be provided for the followings locations, but not limited to.

- Compressor seals
- Lube oil consoles
- Cable cellars
- Coal/ Pet coke/ solid hydrocarbon material handling plant area
- Pumps under racks.

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High velocity Water Spray (HVWS) System to be provided for the followings locations, but not limited to.

- Transformers of 5 MVA and above rating or in case of oil filled transformers with oil capacity of more than 2000 liters, as per CEA Safety Regulation.

7.3 Clean Agent System

The Automatic clean agent protection system shall be provided in control rooms as Per NFPA 2001. The system shall be designed to meet the minimum requirement of total flooding, fire detection, actuation extinguishing requirements as per NFPA 2001. The actuation of clean agent system shall be indicated in the control panel located in the fire station control room & CCR. Preferred clean agents are either Argonite or Inergen only.

7.4 Portable Fire Extinguishers

Powder used in DCP type fire extinguishers shall be MAP 90% ABC powder, UL listed & BIS approved. The number should be determined based on the max. travelling distance of 15 M. At least one fire extinguisher shall be provided for every 250 m² of hazardous operating area. Chemicals/ Consumables used in the fire extinguisher shall UL listed.

Following types of portable and mobile CO₂, dry chemical powder and foam type fire extinguishers shall be provided for the entire plant area at agreed locations as per NFPA requirements. Contractor shall specify the numbers and location for Owner's review and approval. :

- 2 kg capacity dry chemical powder fire extinguisher.
- 6 kg capacity dry chemical powder fire extinguisher.
- 9 kg capacity dry chemical powder fire extinguisher.
- 2 kg capacity CO₂ type fire extinguisher.
- 4.5 kg capacity CO₂ type fire extinguisher.
- 50 litre capacity Foam type fire extinguisher.

2 Kgs, 4 Kgs capacity clean agent Extinguishers shall be provided for Control Room, Computer room, Computer console room, UPS room, Battery room, server/database rack room etc.

7.5 Sand Bucket

Sand buckets filled with sand along with scoops, mounted on structural support stand each with at least 3 sand buckets), shall be provided in Transformer bay, Sub Station, buildings, Technical structure, platforms, Pump house, etc.



The sand buckets shall have round bottom with bottom handle having 9 liter water capacity conforming to IS: 2546. The sand stored in bucket shall be fine and free from oil, water or rubbish. Rain protection of suitable design shall be provided for all sand buckets.

7.6 SAFETY SIGNAGES

Contractor shall provide the safety signages (in English & Hindi language) as per NBC/TAC , at strategic locations, for plant/ non plant areas buildings, technological structure, areas.

Safety signages must be visible under both lighted & darkness conditions.

8.0 Piping System and Valves

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Complete piping, valves, fittings, specialties and pipe supports and necessary electrical item for the fire protection system shall be provided by Contractor inside the Battery limit scope of work..

Hydrant, monitor and spray system piping will be run underground and through Hume pipe at road crossings. Piping will be of carbon Steel pipes (galvanized or ungalvanized) of Carbon Steel as per PMS and coating and wrapping with cold tape. Provisions will be made for extension of hydrant and spray system piping for future extension of the project.

Piping for compressed air, breaching connections, drains, downstream of deluge valves will be of heavy grade galvanized type.

Pipes shall be provided with vent connection and vent valves at all high points and drain connection & drain valves at all low points. All firewater piping shall be capable of being drained completely and provided with drain cocks / valves at low levels.



Isolation Valves at every 300 m and at crossings (junctions) to ensure easy maintenance and uninterrupted water supply in case of break down. All isolation valves in Hydrant system shall be non rising spindle type Gate valve only (For Under Ground Pipelines) and OS&Y type (for Aboveground headers). Isolation Valves above 200 mm NB shall be gear Operated. Material of construction of Gate/Globe/Check valves & strainers shall be carbon steel.

At every 300m and at crossings (Junctions) to ensure easy maintenance and uninterrupted water supply in case of break down and shall be planned in such a way that outage of any section of fire water line should not affect other section. Isolation valves shall also be provided below monitor and at all hydrants. Landing valves on tech structure, platforms, columns, buildings, shall have individual 4" isolation valve at each hydrant. Isolation valve shall be provided at all tapping points on firewater headers.

9.0 SAFETY EQUIPMENTS

Contractor shall provide the following safety items (BIS approved) with minimum qty. specified for their scope of work:

- a) Safety helmets – 10 nos. per control room & per substation.
- b) Stretcher – 4 nos.
- c) Fibre glass First Aid Box with all necessary items/kit & Anti snake serum -2 nos.
- d) Rubber hand gloves for electrical jobs– 10 pairs for each substation and each control room.
- e) Explosimeter- 2 nos.
- f) Fire Proximity suit – 4 nos.
- g) Resuscitator– 2 nos.
- h) Electrical siren (3 Km range) - 1 no.
- i) Hand operated siren - 2 no.
- j) Water jel blanket – 4 nos.
- k) Red/Green flag for fire drill – 10 nos. each color
- l) Positive Pressure type self contained breathing apparatus – 4 nos. per control room & per substation.
- m) Hand held battery loaded Emergency light, each with 1 set spare battery- 4 nos.
- n) Sand Bucket & accessories - 02 sets.

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10.0 SAFETY IN SYSTEM DESIGN

10.1 Spacing and Layout

CONTRACTOR to finalise hydrant layout on plot plan, with all the requirements such as number of Hydrants, Monitors, Foam system, sprinkler system etc., based on all statutory requirements & TAC Guidelines, considering ease of maintenance and safe approach for fire fighting. Due consideration is to be given for providing Emergency escape routes also. Hydrants are to be strategically located to obtain maximum advantage of layout.

11.0 EXECUTION, INSPECTION AND TESTING

All execution, inspection and testing for completion of fire protection system shall be carried out based on Codes, standards and specifications. Contractor shall develop a detail inspection, and testing procedures based on codes, standards and specifications. Following minimum tests but not limited to, shall be carried out after completion of the system testing Fire water network piping

- Demonstration test for system capacity requirements
- Demonstration test for auto start and stops for the main fire pumps and jockey pumps, if applicable.
- Demonstration test for foam application
- Demonstration test for water spray
- Demonstration test for inert gas flooding system, if applicable.

The Contractor shall meet all requirements for inspection and testing of the system.

11.1 INSPECTION

The Contractor is required to organize a proper inspection and expediting system so as to ensure timely delivery of all the items/equipment meeting the specified quality criteria. This function has to be carried out by appropriate deployment of qualified personnel who have wide experience in their respective fields. Inspection of all items supplied under this contract shall be carried out by independent third party inspection agencies like Lloyds/ BV/ TUV/DNV. Third party inspection charges for foreign origin items shall be quoted by bidder. Third Party Inspection shall be done by owner approved third party inspection agencies.



Inspection authority means the Third Party Inspection Agencies (TPIA) approved by the Owner to carryout inspection of materials. The inspecting authority shall have the right to select random samples for check test and reject materials, if samples furnished as above and tested as per the specifications fail to meet the requirement specified.

All the items shall be inspected and tested in the presence of one or more representatives of the purchaser during various stages of manufacturing. Material shall be considered acceptable for dispatch only after final certificate of acceptance is issued by the Inspector. 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.

Quality Assurance plan (QAP) / Inspection Test Plan (ITP) shall be submitted by bidder for approval by Third Party Inspection Agency (TPIA).

The Contractor shall make arrangement for inspection and testing by statutory authorities, if applicable, at various stages of the work.

11.1.1 Scope of Inspection by TPIA:

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- i) Review of MTC (all batches).
- ii) Visual check for surfaces, external appearance (10% random witness).
- iii) Dimensional check (10% random witness).
- iv) Positive Material Identification (PMI) for alloy steels/austenitic steels (10% random witness).
- v) Hydrostatic test (10% random witness for pipes, fittings, valves, strainers, traps, collecting heads, draw off connection, hoses, hose reels, extinguishers, bellows, personnel protective equipments (if applicable for any item), fire fighting/protection equipments. Hydrostatic test shall be 10% random review for other items.
- vi) Any testing/demonstration required as per relevant code/standard/specification: 10% random review.
- vii) Packing: Report review.
- viii) Documentation (MTC, Inspection Release Note): 100% Review

11.2 TESTING

All testing shall be done, as per relevant specifications and/or NIT specifications.

11.2.1 Non Destructive Testing

10% radiography of butt welds and 10% DP/ MP test of fillet welds shall be done for pipe classes in 150# & 300#.

100% radiography on butt weld joints and 100% DP/MP for fillet welds test shall be done for pipe classes in 600# & above.

Radiography procedure, areas of casting to be radiographed, and the acceptance criteria of valves shall be as per ASME B16.34.



The minimum requirement of radiography shall be as under :

Pipe Class	Size (NPS)	NDT Qty
150	Up to 24"	5%
150	26" & above	100%
300	Up to 16"	10%
300	18" & above	100%
600 & above	All	100%

12.0 DOCUMENTATION

Drawings and documents shall be prepared as required by approval authorities in all respects and submitted by the Contractor.

Drawings and documents (4 hard copies, 1 electronic copy & 1 as-built copy of each drawing/document), for fire fighting/fire protection system, design basis, general arrangement/layout drawings of fire water/ spray system/ sprinkler system/fire extinguishers/fire fighting equipments, design adequacy calculations, material specifications, material take-offs (linewise/consolidated), supplier drawings/specifications, inspection test plans, test certificates, spares list, etc. shall be submitted by the Contractor for review/approval/information of Owner/PMC/ Statutory authorities.

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ANNEXURE-1

1.0 Detection, Actuation, Alarm and Communication System

For detail refer electrical and instrumentation specifications attached with the bid document

1.1. General Features Design

- An addressable type of Fire Alarm System shall be provided for the plant. The design shall be as per NFPA and applicable local requirements.
- The fire protection facilities for the Project shall meet the local rules and requirements. These facilities include providing smoke and heat detectors in the buildings.

1.2 Salient Features

1.2.1 Smoke/Heat Fire Detection

The fire detection system shall be made by means of optical smoke detectors, ionization smoke detectors and heat detectors. The above system shall be installed in the control room, electrical sub-stations and other buildings. The signal coming from the above detectors shall be sent to Local Fire Alarm Panels at various locations and in turn to the Main Fire Alarm Panel.

1.2.2 Alarm Push Button Outdoor/Indoor

Outdoor/ indoor Alarm push button shall be located in the plant area/ buildings so that the maximum travelling distance is no more than specified as per NFPA Code. The push buttons shall send the signal to the respective Fire Alarm Panel at various locations.

1.3 Fire Alarm Monitoring System

1.3.1 General

Fire Alarm Main Control Panel shall be provided in Fire Station Building and Sub Control Panels (Local Fire Alarm Panels) shall be provided, one each in control room, and other agreed location.

Fire alarm control panels shall be provided in the respective Non-plant buildings. Interconnection of these fire alarm panels to the main fire alarm shall be done by the Contractor. Summary of Fire alarm to be connected to DCS shall be prepared and approved by Owner

1.3.2 Each fire alarm panel shall be suitable for the following tasks:

- To receive signals coming from:
 - Smoke detection and heat detection systems
 - Manual push buttons to actuate audible and visible alarm for each received signal and a siren for general alarm.
- The control panel shall supply operating low voltage D.C. to the system and have an in-built charging system to maintain in-built batteries, which shall operate the system in the event of mains failure. EDG/UPS power connection shall be provided the fire alarm system.

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- c) There shall be sufficient zones on the panel to quickly identify the area of alarm. Such zones shall either indicate the area on the panel in English with standard model available in the market. NFPA code for zone classifications shall be followed.
- d) The panel shall be capable of supervising faults on the alarm lines, battery leads, batteries, sounders, and contain both audible and visual warnings of such faults within the panel. Only the use of a supervisory key should control such fault indications. Fire conditions must always overcome faults. Indicating lamps shall be dual filament type, having twin lamp circuits or LED type.
- e) It is preferred that the panel shall have an "alarm" and "evacuation" circuit on an automatic basis so that the "alarm" signal shall move to "evacuate" signal within a given period unless controlled with key by a responsible person.
- f) The alarm shall be by electronic hooter and siren capable of giving two distinct sounds - one "alarm" the second "evacuate". The number and location of such hooter and siren shall be determined by a qualified fire protection engineer and be designed to be clearly heard above background noise of the operating plant. The cable feeding the alarm system shall be monitored and protected from fire. Cables for fire alarm system will be fire retardant type. However, the cables and components shall comply with the local regulation requirements.
- g) Manual alarm shall be given by break glass call points which shall be located beside all exits to the open air, or from the department to a safe route, and at all points of high risk. The glass shall be of the fiber glass reinforced plastic type and of copper free aluminium in hazardous area and a test facility shall be incorporated. The instructions shall be in English.
- h) Alarm points in external conditions shall be weather proof and where conditions require this, be explosion proof.
- i) In areas of high background noise, flashing or rotating lamps shall be placed alongside hooter /siren to give visual as well as audible warning.
- j) The system shall also be capable of:
- Accepting automatic detection systems.
 - Closing down air conditioning or similar functions.
 - Having repeater mimic panels added to the system.
 - Serial interface between main fire alarm panel and DCS (to be displayed F&G console) shall be provided. Necessary alarms shall be repeated on DCS.
- k) The use of taped voice messages in English in conjunction with alarm sounder shall be provided.

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TECHNICAL SPECIFICATION OF PERSONNEL PROTECTIVE EQUIPMENT

**PLANT: AMMONIA-UREA PLANT BASED ON COAL
GASIFICATION**

**PROJECT: INTEGRATED COAL BASED FERTILIZER COMPLEX
AT
TALCHER, ANGUL DISTRICT, ODISHA (INDIA)**

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1.0 Safety Helmet

Safety helmets are made of fibre glass shall be supplied and shall confirm to IS:2925 (Latest amendment) & EN-397. These shall be moulded seamless in one piece from natural reinforced fibre glass/polyester resin, which can withstand heavy impact. The helmet shall be made of material highly impact, heat & chemical resistant, high dielectric strength and shall also have better quality abrasion resistance and higher softening temperature. The shell structure of the helmet shall be designed to provide extra strength and toughness. The helmet shall have sweat band and adjustable head band and shall bear IS approval. The colour of the helmets shall be decided at the time of placement of order.

2.0 Safety Goggles

A device worn over the eyes & held in place by a headband used for protecting the eyes & eye sockets from flying particles & injurious radiations, chemical & heat resistant and shall conform to IS-5983.

3.0 Stretcher with Blanket



Stretcher (size 6 feet X 3 feet with tying belts & blanket) shall be supplied and shall conform to IS:4037. Material of the stretcher and other related accessories should be as per the IS standard of practice.

Heavy duty aluminium poles for easy handling and heavy duty, vinyl-coated nylon covers that resist stains and will not absorb body or bodily fluids

4.0 Fiber glass First Aid Box with Medicines

Fiber glass First Aid Box portable type with locking arrangement and compartmentalised storage facility and containing the required first aids as below:

- First aid for cuts, burns, sprains (instant relief sprays) - 1 each.
- Antiseptic lotion, liquids (Dettol / Savlon tincture iodine) - 1 bottle
- Pain relieving medicines, anti vomiting medicines etc. - 2 stripes of 10 each.
- 500 mg Paracetamol I.P - 100 tablets.
- Anti snake serum bottle - 1 No.
- Band-Aids - 20 pcs.
- 25 gms of Soda Bi-Carb. I.P. - 1 pkt.
- Wound dressing small (for fingers) - 12 pcs.
- Wound dressing medium (for hands and feet) - 6 pcs.
- Wound dressing large (for body) - 6 pcs.
- Burn dressing large (for body) - 6 pcs.
- Absorbent cotton wool 13 gms each - 6 pcs.
- Dressing arrangements (scissors / blade etc.) - 1 set.

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- Eye pad with bandage in separate pkt. - 08 pcs.
- Tourniquet cotton with belt & buckles. - 1 No.
- Polythene wash bottle 500 c.c. - 1 No.
- Book of instruction on first aid to injured - 1 No.
- Copy of First Aid Leaflet issued by DG FASLI – 1 No.

5.0 PVC Hand Gloves



Acid alkali proof PVC hand gloves made of superior quality PVC in yellow colour. The fingers and palm should be embossed/ ribbed for better grip. Palm size should be 9" and overall length 14". The gloves should be confirming to IS: 6994/1973(part-ii).

5.1 Nitrile Hand Gloves

CE Marked fully Nitrile rubber hand gloves (In pair) shall have inside soft cotton flocked lining. It shall be able to resist Acid, alkali & solvent while providing solid protection against snags, abrasion, puncture & cuts. Nitrile Rubber hand glove should meet requirement of EN-388 & EN-374. The overall length of the Gloves shall not be less than 12 Inches (from middle finger to end of the sleeve).

5.2 Electrical resistance, Insulating Rubber Hand Gloves in pair (one for Right Hand, one for Left Hand.)- 1100 Volts

1. Four Fingers and One Thumb
2. MAKE: CATU / Honeywell / Oberon / SICAME or equivalent
3. Maximum voltage of use A.C volts: 1000 Volts (rms)
4. Class - 0
5. Size: 9
6. Type: Gauntlet type
7. Max thickness (approx.): 1.6 mm
8. Construction: Seamless
9. Standard: IEC 60903
10. Category: RC
11. Tested by authorized Government Test houses / NABL accredited LAB and relevant test certificate / Batch certificate with hand gloves serial number to be furnished with the material.
12. Made from specially compounded latex or equivalent for complete insulation & totally shock proof.
13. Test certificate of the supplied item to be furnished along with the supply.
14. Packed in sealed plastic bag.
15. The gloves shall be marked indelibly at the back-
 - A) Size, class & category of gloves
 - B) Month and year of manufacturing
16. Following tests will be conducted under inspection of TPIA :

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- A) Leakage current Test
- B) Tensile strength and elongation at break
- C) Resistance to mechanical puncture
- D) AC Proof Test
- E) Flame retardancy Test

5.2.1 Electrical resistance RUBBER INSULATING HAND GLOVES in pair (one for Right Hand, one for Left Hand.)- 36 KV (rms)



1. Four Fingers and One Thumb
2. MAKE: CATU / Honeywell / Oberon / SICAME or equivalent
3. Class - 4
4. Max. Voltage of use A.C volts: 36 KV (rms)
5. Size: 10
6. Type: Gauntlet type
7. Max thickness (Approx.): 4.2 mm
8. Construction: Seamless
9. Confirming to IEC 60903
10. Category: RC
11. Tested by authorized Government Test LAB / NABL Accredited LAB and relevant test certificate / Batch certificate with hand gloves serial number to be furnished with the material.
12. Made from specially compounded latex or equivalent for complete insulation & totally shock proof.
13. Technical catalogue and test certificate of the offered item to be furnished along with the offer.
14. Packed in sealed plastic bag.
15. The gloves shall be marked indelibly at the back-
 - A) Size, class & category of gloves
 - B) Month and year of manufacturing
16. Following tests will be conducted at ERDA
 - A) Leakage current Test
 - B) Tensile strength and elongation at break
 - C) Resistance to mechanical puncture
 - D) AC Proof Test
 - E) Flame retardancy Test

6.0 Portable Explosive Meter cum Oxygen Meter (Explosimeter)



S.N	Particulars	Specification
1.	Use	Able to measure LEL (In Inert atmosphere) and oxygen in zone 0 area.
2.	Type	The metering unit shall be microprocessor based. It shall be suitable for use in open as well as confined space for one hand operation and rugged with casing of protective rubberized over-mold.

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S.N	Particulars	Specification
3.	Sensor	Combustible (LEL) sensor- IR type Oxygen sensor: Electro-chemical type. Sensors shall be replaceable type.
4.	Ambient Condition	0°C to 50°C & humidity: up to 90% RH(non-condensing). (Locations e.g Leh/ Ladakh etc. with extreme weather conditions may decide ambient conditions as per site requirement)
5.	Housing	Minimum IP65 or Better. IP rating should also be tested & certified by accredited agencies like FM/UL/CENELEC/BASSEFA/ATEX/CIMFR/IEC etc.
6.	Area Of Use	The detector shall be intrinsically safe for use in hazardous area classification conforming to Class I, Division I, Group A, B, C & D or Zone - 0, Group-IIA, IIB & IIC, having certified for use by accredited agencies like FM/UL/CENELEC/BASSEFA/ ATEX/CIMFR/IEC etc. and PESO approval at the time of supply of material.
7.	Range	Combustible Gases: 0-100% LEL O ₂ : 0 – 25% by Vol. (Min.)
8.	Sampling Pump	Each instrument shall be fitted with motorized pump with audio and visual low flow alarm.
9.	Remote Sampling Accessories	Minimum 10 feet long sampling hose and sampling probe equipped with quick connect device shall be supplied along with instrument with suitable filter.
10.	Alarm	Minimum 85 Decibel audible alarm at 30 cm & bright red LED flashing visible alarm with vibration. Two levels of alarms for each gas sensed and low battery as minimum. Set points shall be adjustable over entire range.
11.	Battery	Rechargeable Battery (NiMH / Li-ion) shall be suitable for minimum 8 hrs. duration (with pump). Charger operable with 230V+ 5%, 50 Hz, AC supply shall be supplied with each instrument.
12.	Size & Weight	Weight shall not exceed 1Kg. (Including Battery & Sampling pump).
13.	Calibration	Frequency Shall be as per OEM recommendation or once in six month whichever is earlier. Calibration shall be easily performed using instrument's pushbuttons no other special tools will be required. Instrument should show calibration due date. Minimum 4 No calibrations within warranty period to be carried out by OEM or its authorized representative.
14.	Accessories	The instrument shall be supplied with necessary calibration cup/adaptor and calibration tubing to facilitate calibration locally.
15.	Display	Self-illuminating back-light digital display.

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S.N	Particulars	Specification
16.	Fast Response	Maximum 30 Sec. to reach to 90% of measured value The above response time shall be with 10 feet long sampling hose.
17.	Hands Free Operation	The unit shall also have a suitable arrangement for hands free operation.
18.	Rf Protection	Shall be compliant with EMC directive against EMI/RF interferences.
19.	Accuracy	+/- 2% of measured value
20.	Maximum Resolution	Combustible gas: 1.0% LEL O ₂ : 0.1 % by Vol
21.	Performance Guarantee	Minimum 2 years including sensors. The vendor shall guarantee the design, material, workmanship and the performance of the unit for a period of 24 months from the date of supply. Any defect, faulty workmanship or operational defects found during this period shall be rectified by the vendor without any extra cost of Owner/ PMC. Suitable instrument like BG etc shall be furnished by the vendor in line with tender conditions against performance guarantee.
22.	Documentation	Vendor shall be OEM or its authorized supplier having valid authorization from OEM. All other details shall be as per ANSI/ISA 12.03.01(Combustible gases) and ANSI/ISA 92.0.01 to 92.06.01 or equivalent IEC standards.
23.	Inspection, Testing And Performance Parameter	Owner/ PMC reserve its right to get material tested at a lab of repute or vendor to submit third party inspection certificate along with all accessories by Owner/ PMC approved third party inspection agency as per the requirement of Technical Specification. In the event of non-conformity with specifications, Owner/ PMC shall be at liberty to take action as deemed appropriate at its sole discretion. Prior to dispatch of the material from vendor's / manufacture's place the following inspection and tests shall be carried at the vendor place to complete satisfaction of Owner/ PMC representative or his authorized third-party agency without any extra cost to Owner/ PMC for: <ul style="list-style-type: none"> • Visual inspection of Explosi & Oxygen Meter (Explosimeter) to ensure no apparent damage or deficiency. • Examination of documents / certificates / test reports/

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S.N	Particulars	Specification
		instructions/ Guidelines. <ul style="list-style-type: none"> All consumable required for inspection and testing work shall be arranged by vendor at his own cost. Vendor shall arrange all facilities to carry out inspection and testing. Details of field demonstration: Owner/ PMC at its discretion may ask the vendor for field demonstration/ Training for end users at a location specified by Owner/ PMC.
24.	Packing	Material should be packed in OEM packing.
25.	Damage Of Material	Any damage and / or manufacturing defects to the supplied material will not be accepted.

NOTE:



- The default measurement of LEL shall be for Methane. The detector is calibrated to Methane.
- During supply, vendor shall submit operational & maintenance manual, warranty certificate and TPI report along with each instrument.
- Vendor shall supply calibration certificate by OEM for all the sensors. The calibration certificate should contain identification numbers of the sensors & instruments supplied by the OEM.
- Vendor shall clearly indicate the point-wise acceptance/deviation against the above specification in the offer.
- Vendor shall arrange to rectify the defects within two weeks from reporting of the defect at site/owner's premises specified by the owner without any extra cost to owner during warranty period.
- Vendor shall submit the declaration on the cross-sensitivity of sensors with other gasses of concern.
- Owner/ PMC authorized Inspection Agency shall inspect the material before dispatch of the material for quality assurance, testing & performance evaluation as per technical specification.

7.0 Aluminised Fire Proximity Suit.

7.1 General

The suit shall be made up of aluminised glass fabric. It shall be stitched with fire retardant Kevlar yarn or equivalent threads. The material used for the suit, shall not chemically react with water and shall not show any tendency to absorb oil, grease, petrol etc.

The suit shall include hood, coat, pants, boots, mitts and pouch suitable for accommodating BA set. Shoes shall be of standard size with proper insulation and leather lining with non-skid type sole. Metal zip fasteners shall be provided for easy donning and removal of the suit.

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No discomfort shall be experienced while climbing a ladder, in running while carrying a pressurised hose pipe or first aid box. The suit shall get dried easily. The complete set with maintenance manual shall be packed in a strong case / box.

- 7.2 Shelf life : Minimum 10 years.
- 7.3 Donning time : 1.5 minutes.
- 7.4 Protection Level : Outer shell fabric shall withstand a radiant temperature of 2000 deg.F approx.
- 7.5 Size : Regular size suitable for a fireman of height 5'6" to 6'2" approx.
- 7.6 Certification : The fabric of the fire proximity suit shall confirm to the any one of the following standards / specifications
European Standard (EN)
Listed by Underwriters
Laboratories UL 214.

8.0 Resuscitator

The Resuscitator should be as per WHO specifications or UL listed. The resuscitator shall be an intermittent positive pressure respirator type for artificial respiration with a human non-return, non- rebreathing valve. The resuscitator shall be of bag type, manually operated and shall be packed in a transparent bag along with a first aid chart displaying its operation. The resuscitator shall be suitable to be used by an adult person.

9.0 Electrically Operated Siren (Range - 3 Kms)



The general requirements, 3 phase electric motor, siren, heads, starter for on/off operations, without warbling relay, acoustic power shall comply with IS:1941 (Part I)/1976. The Siren shall be approx. range of 3 KMS. It shall be suitable anywhere in the country. Siren shall be horizontal complete with mounting. The electric motor shall be totally enclosed with greased sealed ball bearing and shall conform to IS:325.

10.0 Hand Operated Siren (Range - 1.6 Kms)

The shape, components, material, design and construction shall comply with IS:6026-1970. It shall have portable stand as per IS:6026. The Siren shall be approx. range of 1.6 KMS.

11.0 Low Temperature Gas Protective Suit Suitable for Handling LPG, Liquid ammonia, Propane and Other Toxic Hazardous Gases.

1.	MATERIAL OF CONSTRUCTION	:	Polyamide fabric coated with viton / silicon
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2.	SEAMS	:	Sewn with chemical resistance special thread to ensure leak proof design.
3.	SEALANT	:	Shall be used for the suit for achieving chemical resistance.
4.	GLOVES	:	Shall be made up of the same material used for the suit, and they shall be covered with neoprene as an extra protection. Gloves shall be fixed with the wrist.
5.	COLOUR	:	Cherry / Brownish Red / Yellow
6.	LOW TEMPERATURE WITHSTANDING CAPABILITY	:	The suit shall be able to withstand a low temperature of minus 45 deg. centigrade without any physical damages whatsoever
7.	APPROVAL	:	<p>The Vendor shall enclose latest Test Certificates duly approved by DIFR / GIRDA, clearly indicating the followings:</p> <ul style="list-style-type: none"> - That the gloves can withstand a temperature of minus 45 deg C for a period of 30 minutes. - No cracking, blistering was noticed on the suit after the low temperature test.



12.0 Water Jel Blanket

Water jel blanket (Hydro jel blanket) to be used in case of fire burns shall be supplied the minimum size should be 2.5mX1.5m. It should have necessary approval from any of these agencies (UL of USA, FM of USA, LPCB of UK, and VDS of Germany). Blanket shall be woven out of new wool, impregnated with sterile water based gel. Blanket shall be capable to protect the user from heat, smoke and to provide to the burn victim. The water gel blanket shall bear approvals of IS/DGMS/DIFR or equivalent.

The wool carried is capable of absorbing upto 13 times its own weight. The Water Jel Blanket shall be packed in good quality poly-jar / canister. Water Jel Blanket shall be having 5 years usable life.

13.0 Fire escape mask / filter type emergency respirators

Emergency respirator is a self rescue hood, ideal for escape from room and buildings contaminated with toxic fumes and gases created by fire or accidental pollution. It should be as per IS: 8523.

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14.0 Self Contained Breathing Apparatus (45 Minutes)

Self-contained breathing apparatus (SCBA) suitable for fire fighting, rescue operation in toxic and oxygen deficient atmospheres. The equipment consists of compressed air cylinder, full face wide vision mask (with inner mask), pressure reducer, pressure gauge, low pressure warning whistle, exhalation valve, speech diaphragm, comfortable shoulder harness and light weight back plate, straps, buckles and easy to wear.

The Cylinder shall be capable to operate for 30 minutes. The Cylinder and Valve shall have CCOE approval. BA Set shall be conforming to IS: 10245 (Part-2). One number of spare cylinder shall also be supplied

15.0 PVC suit

It shall be used in handling acid and alkali. Chemical protection clothing can be manufactured from a special grade heavy duty high visibility yellow PVC. The material shall have excellent chemical resistance, high tensile, tear & elongation strength, abrasion, ozone as well as heat resistance. The clothing seam shall be welded by high frequency electrical heating.

16.0 Red and Green Flag



Red and green flag suitable for the fire drill operation shall be supplied. Handle should be made of aluminium. The flag should have minimum of 0.5m x0.30m dimensions.

17.0 Fireman Axe

Forged Axe head, Insulated Handle, IS-926.

18.0 Flame Proof Search Light (Rechargeable safety hand held torch)

S.N	Particulars	Specification
1.	Description	Rechargeable Hand-Held Torch
2.	Power	Rechargeable without removing batteries & Charging in Safe area.
3.	Battery Run Hours	Not less than 3 hours after complete one cycle charge. (To be certified by OEM)
4.	Lumens	Not less than 130 lmn. When measured at a distance of 1-2 Metres for major light (Lumens of the torch to be certified by OEM and NABL/ Govt. accredited Lab.)
5.	Clip/Strap	Strap/ clip
6.	Weight with battery & fittings.	Max. 400 Grms.
7.	Certification	Intrinsically safe for use in hazardous area classification conforming to Zone '0' of Gas Group IIC hazardous area Certified by PESO.
8.	IP	Ingress Protection- Min. IP65 or better (To be certified by OEM along with relevant test certificate)

	TECHNICAL SPECIFICATION OF PERSONNEL PROTECTIVE EQUIPMENT FIRE FIGHTING SYSTEM TFL, TALCHER	PC183-PNMP-TS-PPE	0	
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S.N	Particulars	Specification
9.	Housing/ Body	Housing body should be made of material of Anti-static, high impact properties
10.	Lens	Polycarbonate
11.	DROP Test	2 Meter to be certified by OEM and NABL accredited Lab./ Govt. approved Lab.
12.	Battery with Compatible Charger	Rechargeable, Li-ion / NiMH. Charger operable with 230V \pm 5%, 50 Hz \pm 3% AC supply and compatible charger shall be supplied with each torch.
13.	Light Source	LED only
14.	Marking	As a minimum the product shall have following markings <ul style="list-style-type: none"> Marking towards intrinsically safety of the product. Name of the Manufacturer
15.	Warranty	Minimum one year including battery and battery charger. The vendor shall guarantee the design, material, workmanship and the performance of the unit for a period of 12 months from the date of acceptance at site..
16.	Certification	<ul style="list-style-type: none"> A copy of relevant approval including PESO and other documentation along with the offer. During supply, vendor shall submit operational & maintenance manual, warranty certificate along with each instrument.
17.	Packing	Material should be packed in OEM packing
18.	Damage of Material	Any damage and / or manufacturing defects to the supplied material will not be accepted.

19. WINDSOCKS

LED Illuminated Windsock with heavy duty stainless steel SS-304 Stand.

Made of Stainless Steel SS-304, 360-degree rotating system to rotate the sock to wind

- i) LED light of 20 watt of above suitable for outdoor installation, Cable of size 2C, 1 Sq./mm copper of 10 mtr with LED light.
- ii) Wind Sock made of parachute polyester double lining 2-layer Combination of fluorescent colour red& white or Fluorescent Orange & Lime green with 25 mm wide reflective tape four rows for night reflection of windsock.
- iii) The LED illuminated wind socks frame shall be made of heavy duty SS-304 rod and SS-304 strips with Extended Spokes cage two feet long as per design shown in the photos.
- iv) The frame shall be fixed on rotatable pipe stand 32mm height 5 Feet long with pedestal flange.

	TECHNICAL SPECIFICATION OF PERSONNEL PROTECTIVE EQUIPMENT FIRE FIGHTING SYSTEM TFL, TALCHER	PC183-PNMP-TS-PPE	0	
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- v) Windsock Size: Dia 2 feet × 6 Feet Long made of parachute polyester double lining 2-layer fluorescent colour red & white Combination or Fluorescent Orange & Lime green Combination with 25 mm reflective tape four rows for night reflection.
- vi) Windsock shall be fixed with the frame along with red coloured industrial type weather proof Led lights of 20 watt and above 1 Sq./mm cable fitted with light of 10mtr per with each set.
- vii) The two bearing to be used must be maintenance free and weather proof

20.0 Sand Drum with Scoop

Metal sand scoops with handle of large size manufactured from best quality steel duly painted.

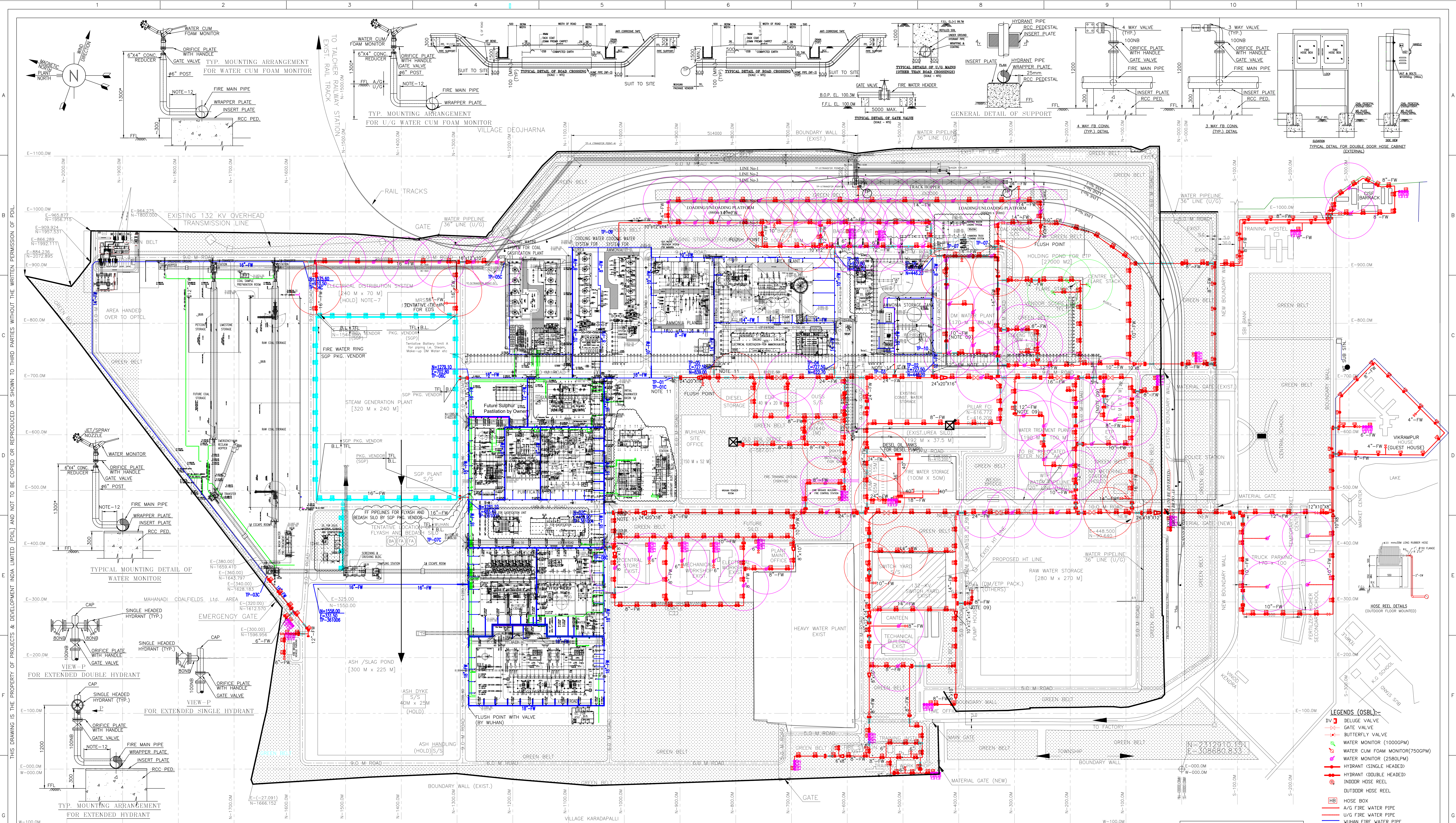


TABLE-1 LSTK FACILITIES/UNITS OF GASIFICATION PLANT

SLNO	BLOCK DESCRIPTION	SIZE IN METRE	REMARKS
01	AIR SEPARATION UNIT	200 M x 100 M	
02	GASIFICATION UNIT	200 M x 100 M	
03	PURIFICATION UNIT	400 M x 100 M	
04	SULFUR RECOVERY UNIT	70 M x 50 M	
05	COOLING WATER SYSTEM FOR GASIFICATION PLANT	980 M x 1600 M	
06	INITIAL MAIN WATER BAY/2	15 M x 30 M	
07	INITIAL MAIN WATER BAY-2	17 M x 23.5 M	
08	COAL WASH WATER PRE-TREATMENT	150 M x 45 M	
09	ELECTRICAL SUBSTATION FOR GASIFICATION PLANT	70 M x 50 M	
10	ELECTRICAL SUBSTATION FOR COOLING WATER	27 M x 36 M	
11	ELECTRICAL SUBSTATION FOR PURIFICATION UNIT	36 M x 28 M	
12	INITIAL MAIN WATER BAY/1	37 M x 30 M	
13	STORAGE & DISTRIBUTION FOR 500 LITRE WATER	37 M x 30 M	
14	ELECTRICAL SUBSTATION FOR ASU	40 M x 47 M	
15	RAW COAL STORAGE	50 M x 37.5 M	
16	PELECOLOCALMINE STORAGE	90 M x 37 M	
17	LABORATORY BUILDING	50 M x 21.50 M	

TABLE-2 LSTK FACILITIES/UNITS OF AMMONIA/UREA PLANT

SLNO	BLOCK DESCRIPTION	SIZE IN METRE	REMARKS
01	AMMONIA UNIT	100 M x 100 M	
02	UREA UNIT	100 M x 100 M	
03	COOLING WATER SYSTEM FOR AMMONIA	50 M x 100 M	
04	COOLING WATER SYSTEM FOR UREA	50 M x 100 M	
05	COOLING WATER SYSTEM FOR AMMONIA STORAGE	80 M x 27 M	
06	TILT WATER TREATMENT SYSTEM FOR AMMONIA	50 M x 24 M	
07	TILT WATER TREATMENT SYSTEM FOR UREA	29 M x 27 M	
08	ELECTRICAL SUBSTATION FOR AMMONIA & UREA	90 M x 28 M	
09	ELECTRICAL SUBSTATION FOR AMMONIA & UREA PLANT	24 M x 20 M	
10	ELECTRICAL SUBSTATION FOR AMMONIA TANK	18 M x 42 M	
11	BIESEL GENERATOR ROOM	82 M x 28 M	
12	GENERAL CONTROL BUILDING	31 M x 28 M	
13	AMMONIA STORAGE TANK	100 M x 170 M	
14	LABORATORY BUILDING	25.75 M x 21.60 M	

TABLE-3 DSBL (PDL/TFL) FACILITIES/UNITS

SLNO	BLOCK DESCRIPTION	SIZE IN METRE	REMARKS
01	DM WATER PLANT	170 M x 180 M	
02	WATER TREATMENT PLANT	100 M x 100 M	
03	ETP	100 M x 100 M	
04	RAW WATER STORAGE	280 M x 270 M	
05	PACKAGING BUILDING	100 M x 26 M	
06	ENGINEERING WORKSHOP	30 M x 30 M	
07	LABORATORY BUILDING	60 M x 30 M	
08	STEAM GENERATION PLANT	300 M x 240 M	
09	ELECTRICAL DISTRIBUTION SYSTEM	240 M x 70 M	
10	DM WATER PLANT	40 M x 50 M	
11	FIRE WATER STORAGE	100 M x 50 M	
12	FIRE WATER PUMP HOUSE	50 M x 30 M	
13	ETP	50 M x 30 M	
14	BISEIL STORAGE	50 M x 30 M	
15	FIRE BRIGADE BUILDING & FIRE CONTROL STATION	25 M x 20 M	
16	FUTURE SELL	45 M x 100 M	
17	TRUCK PARKING AREA	170 M x 100 M	
18	ASH / SLAG POND (ASH POND)	300 M x 225 M	

TABLE-4 DSBL (PDL/TFL) SUBSTATION

SLNO	BLOCK DESCRIPTION	SIZE IN METRE	REMARKS
01	SUB-STATION DM WATER PLANT	70 M x 50 M	EXISTING
02	SUB-STATION WATER TREATMENT PLANT	100 M x 100 M	EXISTING
03	SUB-STATION ETP	100 M x 100 M	EXISTING
04	SUB-STATION BAGGING PLANT	60 M x 40 M	EXISTING
05	SUB-STATION ENGINEERING WORKSHOP	30 M x 30 M	EXISTING
06	SUB-STATION LABORATORY BUILDING	60 M x 30 M	EXISTING
07	SUB-STATION STEAM GENERATION	300 M x 240 M	EXISTING
08	SUB-STATION ELECTRICAL DISTRIBUTION SYSTEM	240 M x 70 M	EXISTING
09	SUB-STATION DM WATER PLANT	40 M x 50 M	EXISTING
10	SUB-STATION FIRE WATER STORAGE	100 M x 50 M	EXISTING
11	SUB-STATION FIRE WATER PUMP HOUSE	50 M x 30 M	EXISTING
12	SUB-STATION ETP	50 M x 30 M	EXISTING
13	SUB-STATION BISEIL STORAGE	50 M x 30 M	EXISTING
14	SUB-STATION FIRE BRIGADE BUILDING & FIRE CONTROL STATION	25 M x 20 M	EXISTING
15	SUB-STATION FUTURE SELL	45 M x 100 M	EXISTING
16	SUB-STATION TRUCK PARKING AREA	170 M x 100 M	EXISTING
17	SUB-STATION ASH / SLAG POND (ASH POND)	300 M x 225 M	EXISTING
18	SUB-STATION BISEIL STORAGE	50 M x 30 M	EXISTING

TABLE-5 DSBL (PDL/TFL) FACILITIES/UNITS

SLNO	BLOCK DESCRIPTION	SIZE IN METRE	REMARKS
01	CENTRAL STORE	70 M x 50 M	EXISTING
02	MECHANICAL WORKSHOP	200 M x 400 M	EXISTING
03	ELECTRICAL WORKSHOP	100 M x 100 M	EXISTING
04	SWITCH YARD	100 M x 100 M	EXISTING
05	PACKAGING BUILDING	100 M x 26 M	EXISTING
06	ENGINEERING WORKSHOP	30 M x 30 M	EXISTING
07	LABORATORY BUILDING	60 M x 30 M	EXISTING
08	FIRE BRIGADE VEHICLE PARKING	100 M x 50 M	EXISTING

- NOTES:-**
- ALL DIMENSIONS AND COORDINATES ARE IN METERS UNLESS OTHERWISE SPECIFIED.
 - REFERENCE BENCH MARK () POINTS IS W.R.T GLOBAL CO-ORDINATES HAVING N-2312910.151 & E-3086800.833 (GRID COORDINATES N-000.00M, E-000.00M)
 - EQUIPMENT SIZES, SUBSTATION AREA AND LOCATION ARE TENTATIVE.
 - BLOCK SIZE OF FACILITIES ARE TO BE FINALIZED AFTER GETTING VENDDR INFO.
 - PIPE RACK LOCATION & SIZES MARKED ARE SCHEMATIC.
 - CENTER LINE OF EXISTING ROAD & PERIPHERAL ROAD TO BE MAINTAINED WITH MINDR ADJUSTMENT & SAME SHALL BE ALIGNED WITH EXISTING BOUNDARY WALL.
 - INSTRUMENTS & THEIR LOCATION SHALL BE PROVIDED BY VENDDR AS PER P&ID.
 - BATTERY LIMIT PIPE SIZES ARE UNDER HOLD. SHALL BE AFTER FINALISATION BY PMC/OWNER/EPC CONTRACTOR.
 - FW ROUTING IS TENTATIVE & SHALL BE FINALISED BY FIRE FIGHTING SYSTEM (CSBL) PACKAGE VENDDR AS PER SITE CONDITIONS DURING DETAILED ENGG.
 - POWER SUPPLY TO FW PUMP HOUSE SHALL BE FROM SUB-STATION (CSBL).
 - * * * DENOTES HOLD.
 - PIPE ROUTING TO SUIT TO SITE.
 - WRAPPING AND COATING REQUIRED FOR U/G PIPING.
 - THIS DWG. SHALL BE READ IN CONJUNCTION WITH REF. DOCS. LISTED ALONGSIDE.
 - VENDDR TO PROVIDE OUTDOOR HOSE REEL AT STRATEGIC LOCATIONS.

TOTAL PLANT AREA = 490.7 ACRE (APPROX.)
AREA FOR NEW PLANT = 326.8 ACRE (APPROX.)
TOTAL GREENBELT AREA = 163.9 ACRE (APPROX.)

LEGEND :-

PROPOSED FIRE WATER PIPELINES (CSBL)	—
WHAM PIPE LINES (ISBL)	—
PLANT FACILITIES	▭
GREEN BELT AREA	▨

EARLIER FW DWG. NO. PC183-7511-0611 RENAMED & ISSUED AS PC183-4012-921-001

0	31.03.2022	ISSUED FOR TENDER	AM	AK/SKM	DM/AMR
REV.	DATE	DESCRIPTION	PPD.	CKD.	APPD.
CLIENT: M/s. TALCHER FERTILIZER LIMITED					
LOCATION: TALCHER, ANGUL DISTRICT, ODISHA(INDIA)					
TITLE: CONCEPTUAL FIRE WATER LAYOUT OF OSBL FACILITY FOR INTEGRATED COAL BASED FERTILIZER AND CHEMICALS COMPLEX					
DRAWING NO: 17125-361000-WSXX_REVDA					
DRAWING NO: 17269-362000-WSXX_REV06					
DRAWING NO: SA/RCF/TALCHER/2017/TOPO-DWG					
DRAWING NO: 501					
DRAWING NO: 635					
DRAWING NO: TPU-M-GN-6341					
DRAWING NO: NUMBERS					
SCALE: 1 : 2200					
FILE NO: PC183-4012-921-001					
DRAWING SIZE: AO					

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SECTION VI-3.2

CONTRACTOR SCOPE OF WORK - INSTRUMENTATION

COAL/PETCOKE/LIMESTONE HANDLING FROM RAILWAY SIDING TO STORAGE YARD

**PROJECT: INTEGRATED COAL BASED FERTILISER
COMPLEX, AT TALCHER, ANGUL DISTRICT,
ODISHA (INDIA)**

0	14.03.23	14.03.23	Issued for Tender	SG	HS	SKT
REV	REV DATE	EFF DATE	PURPOSE	PREPD	REVWD	APPD

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SECTION NUMBER	DESCRIPTION
1.0	Introduction
2.0	Plant location
3.0	Control Philosophy (General)
4.0	Instrumentation Code And Practices
5.0	Hazardous Area Classification & Electrical Execution
6.0	Electrical Supply
7.0	Field Instruments
8.0	Plant monitoring and Control
9.0	General System Requirements
10.0	Misc components
11.0	Local control Panel
12.0	Pneumatic Transmission
13.0	Erection Instruments And Commissioning
14.0	General instrumentation Requirements
15.0	Training
16.0	FAT/SAT
17.0	General terms Of Execution
18.0	Documentation

A. List of Annexure:

ANNEXURE NUMBER	DESCRIPTION
ANNEXURE-1	Instrumentation Accuracies
ANNEXURE-2	Instrument process connections
ANNEXURE-3	System Configuration
ANNEXURE-4	OS/ES/SOE specification
ANNEXURE-5	Cable Sizes

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1.0 INTRODUCTION

Talcher Fertilizers Ltd. (TFL), herein after also referred to as “**OWNER**” A joint venture company of four major Public Sector Units – M/s GAIL (India) Limited (GAIL), M/s Rastriya Chemicals & Fertilizers Ltd. (RCF), M/s ROM India Ltd. (CIL) and M/s Fertilizers Corporation of India Ltd.(FCIL) has decided to build a world class 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 on LSTK basis for building of Coal Gasification based Ammonia & Urea Plant.

Projects & Development India Ltd. (PDIL) has been retained by M/s Talcher Fertilizers Limited as Project Management Consultant for selection of a suitable LSTK Contractor for execution of the project on a Lump-Sum Turnkey basis with Single point responsibility.

This section outlines the general requirements and specifications for Instrumentation and Control System for Design, Engineering, and Manufacture, Shop test, third party Inspection, Supply, erection and commissioning of **ROM COAL/PETCOKE/LIMESTONE HANDLING FROM RAILWAY SIDING TO STORAGE YARD** along with associated facilities.

2.0 PLANT LOCATION

The proposed project will be located within the premises of existing closed coal based Ammonia-Urea complex of FCI Limited, Talcher Unit (refer to plot plan provided elsewhere in this tender document).

The total land area of the site is 933.60 acres out of which lease hold land from Government of Odisha is 923.27 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. FCIL has had full-fledged fertilizer complex of Ammonia-Urea plants at this site which was in operation for over a period of 25 years and closed down since December 2002

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 airport, Bhubaneswar is 150 km, 3 hours journey by road/ rail. Nearest port is Paradip, 200 km by rail/road. Talcher is situated at 21o 10” N Latitude and 82o 5” E Longitude.

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3.0 CONTROL PHILOSOPHY (GENERAL)



- 3.1 Design and installation of instrumentation shall comply with codes and recommendations listed in item 4.0.
- 3.2 All equipments/instruments/system oriented items (with all its sub-systems) shall be of field proven quality both with respect to design and materials. Prototype instruments or instruments of an experimental nature shall not be offered or supplied. In general, all the supplied items by supplier shall have a well proven performance record of operating satisfactorily in a Offsite/Acid Plants for minimum of one year. No instrument requiring special maintenance or operating facilities shall be offered or supplied as far as possible. PTR for field instruments shall be considered min for 2 years.
- 3.3 Preparation of engineering and construction documents like functional schematics, I/O list, logic diagrams for interlocks as per ISA 5.2 with functional descriptions, configuration diagram, electrical load list, cable schedule, cable tray/trench layout, instrument air requirement, nameplate schedule, JB schedule, instrument location layout, electrical instrument signal interface, instrument index, layout drawings, loop diagrams, primary and secondary sketches and bill of materials, any other drawing or documents which is required for package erection & commissioning and SAT as well.
- 3.4 Preparation of all engineering documents for DCS/PLC like graphic schemes of conveyor , instrument loop data base, log formats and any other documents necessary to carry out the system engineering of DCS/PLC.
- 3.5 Co-ordination with Control system vendor for system engineering, implementation, software testing, supply and final commissioning and site acceptance tests.
- 3.6 Co-ordination with all instrumentation vendors for obtaining sufficient information in the form of documents, drawings for engineering and approval from OWNER.
- 3.7 The instrumentation shall be designed to provide stable and accurate plant control ensure safe plant operation and to facilitate plant maintenance, Control and Monitoring. The operating interface to the process shall be colour dual (stacked monitors) screen 22” LED TFT Colour (Minimum) display units with touch facility, presenting overview, group and point displays as well as process graphics with live data. The operator will manipulate all facilities through dedicated operator’s keyboard and using the touch panel.
- 3.8 The Complete DCS/PLC control system i.e. Marshalling panels, Cabinets (System, I/O, PDB, IRP etc.) HMI/Consoles, printers, furniture etc. for the above package shall be

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housed in the new air conditioned substation cum control room for this package. Location control room shall be near wagon tripler/shall be finalized during detail engineering. Location marking to be proposed by bidder within the designated battery limit of the package .The same to be reviewd and finalised mutually by M/S TFL/PDIL.

- 3.9 Control panel room for control room near wagon tippler shall be provided with thickwired glass (min. 5.5 mm thick) on all sides so as to permit operators to have full view on operation of wagon tipper.
- 3.10 The control room shall have console area, engineering room, equipment/rack room, UPS, battery toilets as minimum.
- 3.11 115V AC UPS Panels with batteries & UPS & UPS Power Distribution Boards for Instrument shall be required
- 3.12 1 nos. OS, with dual LED monitors will be used for controlling the package and the same shall be placed on the consoles of CR, 1 no. ES cum OS cum SOE will be placed on the consoles of Engineering room.
- 3.13 1 no. OS will be placed in the Ammonia Urea Control room Control room.
- 3.14 One no. Aux. Console with Ann. window, push buttons, switches for critical trip and alarm shall also be provided.
- 3.15 RIO shall not be considered anywhere in the package.
- 3.16 Package Unit PLCs :

Bidder to provide PLC (DMR) with redundancy at all levels for Wagon tippler, Paddle feeder ,conveyor etc. with latest model / software /license. It shall have provision to communicate with main DCS system (Ammonia Urea control room) through Modbus protocol/ OFC in redundant mode. Overall plot plan elsewhere attached with Tender to be referred by Bidder for determining distances and proposing cable routings. Main programmable Logic controller based system for the package including marshalling cabinets, relay cabinets, MCC Interface cabinets, power supply distribution cabinets, instrument isolator, alarm cards, terminals, relays with accessories duly mounted, wired & tested to meet specified requirements.

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3.17 DIs/DOs from MCC to control system or from control system to MCC shall be with relays only (no fuse shall be considered). Separate panels for DI/DO and AI/AO. The details will be discussed during detailed engineering.

3.18 Alarm and Annunciation System (LED type only):

Annunciation system is used to indicate and sound alarm for any process abnormality, trip/status change of Electric drive. Annunciation system shall be of modular design & programmable type. Electrical circuit is designed to read the change of state of discrete signal and generate the output to illuminate the window and give the alarm. The alarm can be silenced by acknowledge switch. Window light can be reset after acknowledgement and, when the state of signal returns to the prior alarm state. Annunciation system can be configured for any of sequences of ISA standard. There shall be a provision in circuit design to change the state of signal required to generate alarm (from Open to Close or vice versa) simply by changing the jumper position on circuit board. Lamps in window shall be replaceable from the front.

Hooter in general, shall be solid state type with audibility of the order of 100 dB at the distance of minimum 3 meters. An interruption of power supply up to 20 m-sec shall not affect the functioning of unit.

The minimum instrument accuracy shall be as defined in Annexure-1.

3.19 Universal HART Protocol with Latest Revision shall be used in all cases.

3.20 Card mounted Relays are acceptable but cards must have redundant power facility, with its power healthiness indication in diagnostic graphics.

3.21 Cable entry to control room, substations shall be through MCT blocks with SS316 MOC only.

3.22 Entry into the Marshalling Panels in the control room shall be through bottom mounted 316SS MCT blocks.

3.23 General Earthing & Instrument Earthing shall be provided separately (Panel and power earthing, PLC system earth and Instrument signal earth is minimum envisaged).

3.24 All wetted part materials for all instruments (sensing elements) for corrosion prone area shall be min SS316L.

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- 3.25 The Instrument item like control valve, pressure relief valve, orifice flanges, level instrument, thermowell etc., coming on pipe and vessel under IBR services shall be certified by IBR or IBR authorised representative, even for SS metallurgy.
- 3.26 All Contacts shall be 2 SPDT .
- 3.27 All Field transmitters for pressure, d/p, level and flow shall be microprocessor based (dual compartment) SMART transmitters with “UNIVERSAL HART” protocol with latest revision. The transmitter selection shall be such that the operating maximum upper limit shall be around 70% of the total measurement range of the transmitter.
- 3.28 All Field transmitters for pressure, d/p, level and flow shall be provided with 10 years stability (0.1%).
- 3.29 Package vendor shall provide a common laptop (latest configuration 8th Generation Intel i7 8550U processor, Windows 10 Pro OS, 8GB RAM, 256 GB SSD+, 1TB HDD, Full HD display (15"),3 yr warranty with anti-virus and other engineering software) for configuration of dedicated vendor standard PLC (PLC for wagon tippler conveyor etc)
- 3.30 Motor / electrical equipment control philosophy
- a. Field :
 - Ready to START (Lamp)
 - START
 - STOP
 - L/R Switch
 - b. For Package PLC
 - STOP Command
 - Discrepancy Alarm
 - Running Indication
 - Motor Fault Alarm
 - Current Indication (All motor > 5KW)
 - L/R Switch Indication
 - Ready to START F/B
 - c. For start / stop of all electrical equipments, local/remote selector switch shall be located in field, A/M (Auto/ Manual) and stop push buttons on consoles in CR.
 - d. Local stop push button on LCS (local control station) shall be always effective.

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- e. In remote mode, motor can be stopped from control system.
 - f. In LOCAL mode, both START and STOP shall be possible only from LOCAL. Only in REMOTE, stopping is possible from control system.
 - g. Auto / manual selection shall be in PLC/Main Control System.
- 3.31 For all motors current indication shall be provided in control system for rating more than 5 KW.
- 3.32 Auto start for pumps must be designed using 1oo2 philosophy.
- 3.33 All Instruments including volume bottle must be painted with Corrosive resistant epoxy paint.
- 3.34 Local indicators, start /stop switches, emergency stop switches shall also be provided near package units/rotating machines where local start up of the equipment is advisable.
- 3.35 For instrumentation electrical interface, input and output contacts shall be in separate multicables (should be signal cables).
- 3.36 Emergency stop and critical stops must have transparent protective cover.
- 3.37 PB's , Annunciator , EPB must be available on console placed in CR.
- 3.38 All control valves / On–Off Valves / MOVs shall be flanged type.
- 3.39 Control valve / on-off valve, pneumatic valve shall be designed for minimum 4 Kg/cm2 air pressure.
- 3.40 Actuator design shall be of 1.5 times of shut off pressure or design pressure, whichever is higher.
- 3.41 Valve body MOC in steam service shall be of WCC or better irrespective of pipe class.
- 3.42 Air distribution pots shall be of stainless steel (SS304). Inst. Impulse pipes / tube for process parameters shall be in accordance with piping specifications.
- 3.43 FRP Canopies (UV stabilized 3 mm thick), 2” Pipe mountable, are required for Transmitter, JB's, LCP's, Control Valve positioner, Temp Elements, Proximity level switch, remote mounted electronics, mass flowmeter, ultrasonic flowmeter etc. FRP Canopy shall be Prefabricated type. Canopy for transmitters shall cover top and 3 sides. SS canopy instead

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of FRP, if offered by package vendor, shall also be acceptable. No separate canopy shall be required for instruments located under shed like compressor shed etc.

- 3.44 System / Marshalling/ Packages cabinet size shall be 2100 (H) X 1200 / 800 (W) X 800 (D) Rittal make. This size is applicable for Control room panel not for standalone local panels.
- 3.45 For all Local panels rain cover to be provided. The gasket of local panels must be acid resistant preferably Silicone/EPDM or better which will be discussed during detailed engineering.
- 3.46 Fibre optic cables shall be armoured, multicore type. All fibre optics cable must be laid through HDPE conduit. The make of fibre optic cables shall be Belden / Leoni.
- 3.47 Fire Alarm system & Fire and Gas detection system(if applicable) shall be interfaced with the Central fire control room, all the necessary communication up to the central fire system PLC shall be in bidder's scope. Including supply of OFC and network switches etc. Any alarm generated in ROM COAL/PETCOKE/LIMESTONE HANDLING units shall be displayed at Fire Control Room. Repeater panel at central fire control station shall be in bidder scope. For more details regarding Fire alarm system kindly refer Electrical section of Tender . Overall plot plan elsewhere attached with Tender to be referred by Bidder for determining distances and proposing cable routings upto Fire control room.
- 3.48 All cables inside package battery limit shall be supplied and laid by Package vendor through instrument cable trays supplied by Package vendor. All cables inside skids/modules shall be supplied in pre-wired & pre-tested condition.
- 3.49 All fittings shall be SS316 and in "inch" only.
- 3.50 All tubing shall be SS316 and must be made from hot extrusion process only.
- 3.51 The manifolds (3 valve/5-valve/2 valve) material shall be SS316L.
- 3.52 All the soft parts of Local panels/JB/SOVs etc shall be of acid resistance, preferably silicone, EPDM or better which will be discussed during detailed engineering.
- 3.53 For all Diaphragm Seal Type DP Transmitters/Gauges on Vessels, min size and rating shall be 3" 300# RF. Isolation valve shall be BALL type

4.0 INSTRUMENTATION CODE AND PRACTICES

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IEC 13	Diagrams, Charts and Tables, Preparation of Logic Diagrams
IEC 534	Industrial - Process Control Valves
IEC 584	Thermocouples
IEC 605	Equipment Reliability Testing elements
IEC 611-12	Part 12 Graphical Symbols for Diagrams. Binary Logic
IEC 654	Measurement and Control equipment
IEC 751	Industrial Platinum Resistance Thermometer Sensor
IEC 801	Electromagnetic Compatibility for Industrial Process measurement and Control Eqpt.
IEC 848	Preparation of Function Charts for Control Systems
IEC 902	Industrial Measurement and Control Terms and Definitions
ISA S-5 .1	Instrumentation Symbols and Identification
ISA S-5.2	Binary Logic Diagrams for Process Operation
ISA S-5 3	Graphic Symbols for Distributed Control/Shared Display Instrumentation, Logic and Computer Symbols
ISA-S20	Instrumentation specification formats
ANSI/ISA S 5.1	Process Instrumentation Terminology
ANSI/ ISA S71.04	Environmental conditions
ANSI/ ISA S75.01	Control Valve Equations
ANSI/ ISA S75.02	Control Valve Procedure Capacity Test
ANSI/ ISA S75.03	Face-to-Face Dimensions for Flanged Globe Style Control Valve Bodies
ANSI/	Quality Control Standard for Control Valve Seat
FCI 70.02	Leakage
BS 6020	Instruments for the Detection of Combustible Gases
DIN 43760	Measurement Standard for RTD.
DIN 19243	Measurement and Control Electrical Sensors, Electrical Position Sensors and Signal Converters used for Intrinsically safe two-wire DC System.

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EN-50-014/020	Electrical Apparatus for Potentially Explosive Atmospheres
EN 54 Part I	Components of Automatic Fire Detection System Introduction.
EN 54 Part 5	Heat sensitive Detectors - Point Detectors containing a Static Element.
ISO 3511.1	Process Measurement Control Functions and Instrumentation Representation Part I: Basic requirements.
ISO 3511.2	Process Measurement Control Functions and Instrumentation Representation Part 2: Extension of Basic Requirements.
ISO 3511.4	Process Measurement Control Functions and Instrumentation Representation Part 4: Basic Symbol for Process Computer, Interface and shared Display/Control Systems.
ISO 4200	Plain End Steel Tubes, Welded and Seamless - General Table of Dimensions and Masses per Unit Length.
ISO 5167	Measurement of Fluid by Means of Orifice Plates, Nozzles and Venturi Tubes Inserted in Circular cross-section Conduits Running Full.
API RP 520	Sizing, selection and Installation of Pressure relieving devices in Refineries
API RP 521	Guide for Pressure Relieving and Depressuring System
API RP 2000	Venting Atmospheric and low-pressure storage tanks
API-RP-550	Manual on Installation of refinery Instruments Part I and Control System
ANSI - B 16.104	Control Valve seat leakage
ISA-S 75.01	Control Valve sizing
ISA S 18.1	Specifications and guides for the use of general Annunciators.
IEC 529	Environmental Protection of equipment
ANSI B 2.1	Pipe threads
ANSI B 16.5	Steel pipe flanges, flanged valves and fittings
IEC 79.11/	Intrinsic safety code and practice
IEC-79.14	International Boiler Regulation
IS 2148	Flameproof enclosure of electrical apparatus
BS EN 62676 series	Video surveillance systems for use in security applications
BS EN 62676-1-1	Video System Requirements

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- BS EN 62676-1-2 Video Transmission – General Video Transmission – Requirements
- BS EN 62676-2-1 Video Transmission Protocols – General Requirements
- BS EN 62676-2-2 Video Transmission Protocols – IP Interoperability implementation based on HTTP and REST services
- BS EN 62676-2-3 Video Transmission Protocols – IP Interoperability implementation based on web services
- BS EN 62676-3 Analog and Digital Video Interfaces
- BS EN 62676-4 Application guidelines

The equipment and materials to be furnished shall be designed, manufactured and tested in accordance with the latest revisions of the Indian Standards (IS). Where Indian standards are not available International standards like British Standards (BS), ISO, DIN, JIS or Other standards and International Electro-Technical Commission (IEC) publications unless otherwise stated, which ensures performance equivalent or superior to Indian standard shall be followed.

The equipment conforming to any other national standard which ensures equivalent quality is also acceptable. In such cases the bidder shall clearly indicate the standards adopted and furnish a copy of the English Version of the Standard along with the tender.

The equipment covered under these specifications shall comply with all the latest applicable statutory rules, regulations, acts and safety codes which may be in force during the period of execution and which are related with design, construction and operation of equipment in the locality where the equipment is to be installed.

Wherever service conditions and requirements laid down in these specifications differ from applicable standards, the conditions specified herein shall prevail.

The technical parameters to be furnished are subject to scrutiny/approval at the detailed design stage that may undergo minor changes keeping in view the system requirement and various codes of practices/regulation by the statutory bodies. This is also true for drawings. The parameters not specifically mentioned in the bid document shall be decided at the time of detailed engineering subject to owner's approval.

All drawings shall comply with current Indian Standard specifications and shall be sufficiently detailed with dimensions and shall be clear and legible.

In case of any conflicts between the requirements of this specification and other referenced documents, the more stringent shall apply.

In addition, any relevant regulations applicable to the work shall be followed. In case of any discrepancy, the decision of purchaser will be final.

The BIDDER must execute the works, in accordance with the technical specification and applicable standards.

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Material supply including design and the installation of equipment and material shall comply with all relevant Government Acts and Regulations, International Standards and codes having jurisdictions over them.

In general, the order of precedence shall be:

- ✓ Contractor scope of Work –Instrumentation
- ✓ Government Acts and Regulations.

5.0 HAZARDOUS AREA CLASSIFICATION & ELECTRICAL EXECUTION

5.1 The execution of instrumentation shall be as per area classification , however minimum ingress protection shall be as below

Electrical / Electronic instruments	IP 67
Sensors; RTD, T/C, etc.	IP 65
Local Gauges; PG, etc.	IP 55
Pneumatic instruments	IP 54
Solenoid valves	IP 67
Local Panel / Skid Mounted Panels	IP 55

EMC compatibility and electrical safety as per latest IEC standard.

5.2 Electrical instrument equipment shall be designed for and supplied as intrinsic safe certified.

Certification for installation in hazardous areas in accordance with IEC 60079 series is shown below:

Transmitters, positioners, Limit Switches, etc.: EEx ib IIC T6

Field Switches: EEx de IIC T6

Analysers and Panels: Ex p IIC T6

Solenoid Valves: EEx ib IIC T6 (Ex md not allowed)

Junction Boxes and Cable Glands: Exe/Exd

6.0 ELECTRICAL SUPPLY

The electrical supply will be as follows:

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S.No.	Description	115 V AC 50Hz UPS	110 V DC	24V DC	110 V AC Non UPS	240V AC 50Hz (Non UPS)	415 V AC-3 phase	Remarks
1	PLC/DCS	YES						
2	Package Units	YES				YES		Non UPS for Lighting
3	Alarm Annunciator	YES						
5	Solenoid Valves			YES				
6	Smart Positioners, I/P, Transmitters			YES				
7	I/P Interrogation Voltage			YES				
8	Gas Detectors			YES				
9	Analyzers and Analyzer System	YES						
11	Level Gauge Illumination					YES		
12	Cabinets Fan					YES		
13	Cabinets Lighting					YES		
14	Control Room					YES		
15	Local Panel	YES		YES		YES		Non UPS for Lighting
16	CCTV	YES						
17	Analyzer Cabinet Air Conditioning	YES						
18	Analyzer Shelter HVAC						YES	
19	Normal AC for Field Operator Room					YES		

Where 24V DC is needed, it will be generated by local rectifier units (bulk power supply with MOSFET O-ring), which are part of the instrumentation supply. The power supply to these units shall be taken from the UPS.

Where 24V DC are used for Safety Circuits, the rectifier units shall be duplicated and with high reliability and form a part of DCS/PLC vendor. The bulk power supply shall be with MOSFET O-ring.

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There shall be minimum 4 (two no. Of each type; total 8 nos.) separate earth pits for signal (IS) , Non IS, Panel and chassis (system) grounding for DCS/PLC Earthing system at Control Room with different cable colour codes. All earth shall be less than 2 Ohm or OEM specific, if better. The size of Earthing Cable shall be 50 sq.mm minimum and should be routed in proper HDPE conduit, outside the control room building. All above instrument earth pits shall be separate from Electrical earth pits and must have separate colour identification from electrical earths. Minimum 2 nos. Of earth pits of each type (total 8 nos) shall be constructed by the bidder.

Supply of earth electrodes, grounding cables (separate for signal grounding and instrument grounding) and other related accessories required for barrier earth, system earth and installation shall also be in the scope of work Contractor. Copper conductor shall be of 1Cx10 Sq mm as minimum. For surge protection devices separate earthing shall be used.

Grounding requirement for other system to be taken care by Contractor

Earthing of all new equipments / instruments located at control room for New PLANT of new earth pit at control room with all cables, electrode, pit shall be provided by contractor.

UPS supplies shall not be used for utilities supplies cooling fans, panel/cabinet lighting etc. A separate non-UPS supply shall be used for the same.

A summary of all critical UPS alarms, 24V DC supply, Panel supplies, diode o rings healthiness shall necessarily provided in control system system and hardwired annunciation in control room or any manned location

Only tinned copper cables & tin-plated copper lugs shall be considered for instrumentation power distribution system.

UPS shall be in bidders scope. Further distribution to the bidder system in the CR, Field operator room and in the field shall be in the bidder scope. Therefore necessary PDB shall be provided by the bidder to distribute power supply.

Protection coordination with respect to fuse/MCB ratings from the supply source ACDB/DCDB to downstream distribution panels shall be thoroughly studied by the system designers/OEM and documented as a part of the system documentation and be implemented accordingly.

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MCB's must have DI contact's which must be wired to DCS/PLC and available in diagnostic graphics.

7.0 FIELD INSTRUMENTS

7.1 Pull Cord Emergency Switches

Pull chord switches shall be provided along the entire length of conveyor for emergency stopping of the conveyor. Spacing shall be at an interval of 30 m (approx.) along with the conveyor and at least one switch shall be provided for small conveyors near drive heads & tail ends. It shall have cast/ metal clad and weather proof enclosure. The pull chord shall be of adequate length and shall be of standard flexible galvanized wire. Pull chord switch shall have operating signal facility. All pull chord switches shall be provided with indicating lamps so that pull chord switch under trip can be easily identified. Heavy duty enclosed epoxy painted dust and vermin proof Pull Cord Switches with IP-65 degree of protection shall be provided on both sides of conveyor at intervals of about 30 metres. Pull Cord Switches shall be microprocessor based system for higher degree of reliability and stable operation in noisy/dusty/humid/hot environment. It shall have intelligent Digital or Analog communication between the electronic sensors mounted inside the switches and Master units

(Belt Monitoring panel) placed at Head End of each conveyor(s). The baud rate and response time shall be less than millisecond and uniform for all sensors. Master unit shall have four potential free changes over relay output contacts (2 NO/2 NC) suitable for 24 V DC / 10 A, 115 V AC. It shall have built-in switch mode power supply. Master units shall have RS-485 communication port and Ethernet (10 MBPS) TCP/IP. It shall be communicated with PLC systems.

The switches shall have a vertical lever with a suitable rope clamping device. It shall be feasible to actuate the switch in a maintained mode by pulling on the rope from either side of its normal vertical axis. A manual resetting lever shall be provided to reset the switch to its normal position.

All internal connections shall be wired up and terminated in a terminal block inside the terminal box. Two numbers of earthing terminals suitable for 8 SWG GI wire shall be provided on the body of the switch. The actuation of these switches shall stop the motor in either the Local or Auto modes. The sensors shall have 2 NC+ 2 NO potential free contacts suitable for 24 DC/115 V AC. Any open link (cable/contact) in the serial pull cord switches shall be annunciated both at Master Control Unit and Central Control Room. The

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CONTRACTOR shall ensure that the voltage drop at the receiving end of the control cable connections is within acceptable limits to ensure reliable operation and that delay in delivery of a stop signal to the drives is the minimum.


The cables to PLC shall be isolated from the power cables by at least 300mm spacing, while laying.

7.2 Belt Side Travel Switches (BSTS)

Belt sway switches shall be provided in pairs to keep the belt sway within permissible limit. The spacing will be at an interval of 50 m (approx.) with a minimum of two pairs to each belt conveyor. It shall be provided with common bridging by pass switch at the central desk which shall be required to be used during starting and also during emergency. Heavy duty long vertical roller lever type belt side travel switches in epoxy painted IP65 protected enclosure, shall be provided on both sides of Belt Conveyors at transition point near head end and tail end respectively. Sufficient over travel shall be provided to avoid damage during impact of the belt. This switch shall be a momentary contact/self-reset type. Each switch shall have 2 NO + 2 NC potential free contacts suitable for 24 DC/115 V AC and shall be wired to an internal terminal block.. Two numbers of earthing terminals suitable for 8 SWG GI wire shall be provided on the body of the switch. These switches shall operate both in the Auto/Manual mode and shall stop the drive only after an adjustable time delay. These switches shall be mounted on both side of the conveyor and at 50 M distance in the entire length of the conveyor and shall be connected to Master unit of each conveyor located at respective transfer tower.

7.3 Zero Speed Switches

Zero speed switch shall be provided at the tail end or preferably on drive end of each conveyor to keep the operational speed within a set limit. It shall stop the conveyor if the speed exceeds or falls below the present limit. It shall have cast/metal clad dust and weather proof enclosure. A non-contact electronic type Zero Speed Switch shall be provided on a tail end pulley of each Belt Conveyor. The switch shall have a sensing device. The switch shall serve to interlock the feeding conveyor and stop it or prevent it from starting if the pulley is not rotating at a preset speed (security for speed setting shall be provided). Suitable control cable shall be provided for connection between the sensors. 115 V AC UPS power supply cable shall be provided for the monitoring unit. The actuator shall also be in the scope of supply and shall be mounted on the tail pulley. Each switch shall have 2 NO + 2 NC potential free contacts suitable for 24V DC /115 V AC and shall be wired to internal terminal blocks. Two numbers earthing terminals suitable for 8SWG

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GI wire shall be provided on the enclosure of monitoring unit. The component enclosures shall meet IP65 protection standards. Adjustable initial time delay and nuisance time delay shall be provided. Adjustable speed setting shall be provided. Sensor probe shall be of SS with minimum IP65 rating.

7.4 Belt Take Up Switches

These switches shall be provided and installed so as to be actuated by an extreme movement of the conveyor belt take ups, should the belt tension not be adequate for any reason. Each switch shall be dust and vermin proof and shall have a degree of protection IP65 with SS material enclosure. Each switch shall have 2 NO + 2 NC potential free contacts suitable for 24 V DC/115 V AC and shall be wired to an internal terminal block.

7.5 Chute Plug Switches

RF admittance type /Tilt type chute plug switch as per application requirement, shall be housed in cast iron body with IP65 degree of protection and 2 NO + 2 NC contact block having 10 A at 115 V AC rating. It shall be possible to change NO contacts into NC or NC into NO at site. It shall be provided for tripping the feeding conveyor in the event of high level or chocking so as to prevent spillage. The material to be handled is having high moisture and of highly abrasive nature with temperature upto 90°C.

7.6 Vibration Sensors

4-20 mA loop powered vibration sensors with SS case material and integral cable shall be considered. Protection class shall be IP66 or better. Frequency range and type shall be selected based on the application. Necessary mounting pads/studs on the motor /pump shall be provided. Necessary junction box for field termination shall be of IP65 protection class.

7.7 Field Hooters

These shall give an audible alarm before a conveyor, or movable head pulley commences to move; both in the auto/manual and local mode. The hooters shall be capable of sounding continuously

for a pre-settable interval. The alarm/ siren shall be motor driven. It shall work on 220 V AC, 1 phase for 0.5 km range. More than one shall be installed for long conveyors. Adequate numbers/conveyor shall be provided to ensure their audibility along-side the full

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conveyor length. The CONTRACTOR shall indicate the numbers required, the db ratings and the spacing to suit the db ratings proposed in his bid.

The housing of the hooters shall be IP-65 protected and shall have the appropriate terminals, cable connectors and grounding lugs.

7.8 Motorized Valve / flap gate / diverter with Electric Actuator

Industrial type, ON-OFF control, single seated, inline ported, motorized valve with electric actuator with integral starter consisting of the following:

1. Motorised Valve

Size : As per requirement

Construction: Body, bonnet & blind – As per piping specification / elsewhere specified in this tender

2. Actuator

Power : as per requirement

Housing : Aluminium silicon alloy heat treat.

Gears : Bakelite/ Steel, hobbed, toughed gears


Electric motor : Three phase, permanent split phase capacitor type class “F” insulated motor.

Power Supply : 415V AC , 50 Hz, AC

Actuator shall be as per area classification with environmental protection of IP 65 or better. All the bolts and nuts used in the actuator, bonnet and other parts of the valve body shall be made of stainless steel. The actuator shall be oversized to at least 25% of sizing.

Actuator shall be provided with following control status indicated on DCS/ PLC:

- Valve opening, closing or moving
- Valve full open
- Valve full close
- Valve position at intermediate
- Motor tripped on torque in mid travel, motor stalled
- Remote selected
- Actuator being open by handwheel

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All the accessories required for safe operation and control of actuators shall be Included in the scope of supply but not limited to the following:

- a) Electrically and mechanically interlocked contractors for opening and closing direction.
- b) Fuses and thermal overload relay for protection of motor and control transformer.
- c) Push buttons for opening/ closing and stopping of valve operation.
- d) Thermostat/ thermister with electronic controller for protection of motor.
- e) Separate torque and travel limit switches for both Open and Close positions.
- f) Incoming power supply isolating switch.
- g) Indicating lamps for valve fully open, fully closed and 'in-travel' condition.
- h) Space heater preferably with control thermostat.
- i) Local continuous position indicator.
- j) Terminal block fully pre-wired upto contacts on individual devices.
- k) Control transformer
- l) 2 nos. earthing terminals.
- J) Hand wheel for manual operation, suitably interlocked to prevent simultaneous manual and electrical operation.


7.9 Pneumatic Control Valve

Body, disc, stem and seat material shall be considered as per application requirement and to meet Leakage class-VI. Positioner for control valves shall be SMART type Electro-Pneumatic. All instrument & valve hookup material & impulse tube shall be of SS316 and pressure class shall be as per application requirement. Positioner for control valves shall be SMART type Electro-Pneumatic Solenoid Valve

Type : Double solenoid

Materials : SS316

7.10 Electronic Belt Weigher

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Electronic type belt weighers shall be provided at the strategic locations of the plant as required with the following: Model selected for belt weigher shall be approved by Statutory authority (Weights & Measure department) & necessary documentation & stamping shall be in scope of contractor.

7.11 Load cell with Digital Weight Indicator

Type: Double Ended Shear Beam Load cell

Housing – Hermetically Sealed IP 68 Minimum

Material – SS316

Supply Voltage – 24 VDC loop powered

Capacity – As specified in tender

Zero balance – less than +/-1% of FS

Temperature effect- Negligible

Side Load effect – Negligible

Gasket – EPDM /Silicon

Combined Error – 0.015% of FS

7.12 Digital Weight Indicator

Type: Microprocessor based field mounted

Input from – Load cell

Linearity - <0.01% of FS

Material – SS316

Gasket – EPDM /Silicon

Supply Voltage – 24 VDC loop powered

Display with status LED & Keyboard – 8 Digit LED type

Output – 4-20 mA HART latest version , RS-485 SI

Hazardous Area – Zone 2, group IIC, T6, EExib

With all mounting accessories , hooks SS , tying clips SS , FRP canopies etc. to full fill all tender requirements.

Belt Slip

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Optical high resolution encoders shall be installed on each drive pulley shaft and either on the belt or preferably on a non-driven pulley shaft near the drive pulley. The speed of each driven and non-driven pulley shall be compared to detect belt slip. Momentary slip and belt underspeed shall trigger an alarm in the control system. A prolonged slip condition will trip the conveyor. Optical encoders output shall also be used in the PLC logical to detect underspeed and overspeed conditions.

7.13 Belt Alignment

Belt alignment is verified at the entry and exit of each pulley area using mechanical belt missalignment switches. When the allowable belt miss-alignment limit is exceeded then an alarm is raised in the SCADA system.

Typical locations for belt miss- alignment switches on entry and exit include:

- Tail loading station
- Head discharge pulley
- Drive station
- Take-up

7.14 Blocked Chutes

All chutes shall include a blocked chute detection device with a minimum of two (2) different devices installed to ensure the condition is detected. A blocked chute condition shall trip the conveyor. The blocked chute detection devices used depend upon the chute type and material characteristics being handled and include:

- Tilt switch device
- High frequency (140GHz) radar level transmitter / system
- Microwave through chute device
- Blow-out panel or door and proximity switch device

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7.15 Take-up Travel

The take-up runway and take-up counterweight tower shall incorporate travel limit switches approximately 250mm from each travel limit. The travel limit switch shall continuously detect the movement of travel beyond the limit. Exceeding the take-up travel limits shall trigger an alarm and stop the conveyor with an operational stop.

7.16 Thermal Monitoring

All motors, flywheels, gear reducers and pulley bearings shall include RTD temperature sensors for continuous monitoring. If a bearing high temperature is triggered then an alarm will be raised in the SCADA system. Prolonged period of high temperature levels will trip the conveyor

7.17 Pipe Conveyor Overfill Switches

Pipe conveyors shall incorporate minimum two (2) pipe conveyor overfill switches configured to detect when the conveyor cross sectional fill is exceeded. The conveyor will trip if overfill is detected to prevent idler, structure and belt damage.

7.18 Rip Detection

At least one String Type Rip Trip Switch and one Pan Type Rip Trip Switch shall be present halfway between two idler frames, immediately after the load point on each conveyor. At least one String Type Rip Trip Switch shall be present over the tail pulley and over a head end bend pulley. All belts shall include embedded rip detection sensor loops. The distance between sensor loops shall not exceed 100 m.

7.19 Level Instruments

Continuous level measurements of materials in hoppers, bins, liquid materials, etc., shall be High frequency (140 Ghz) Radar Level Transmitter type.

Level switch shall be avoided, if not possible (shall be decided during detail engineering) suitable design and type shall be used for a distinct and fixed level in bins, hoppers or on stockpiles.

7.20 Pressure Gauge/Switch (to be provided with isolating valves, gauge cock, snubber and syphon)

- | | |
|---------------|------------------------|
| (i) Dial size | 150 mm |
| (ii) Accuracy | (+/-) 1% of range span |
| (iii) Bourdon | AISI 316 SS |

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(iv) Block	AISI 316 SS
(v) Movement	AISI 316 SS
(vi) Case and Bezel	Die cast Alum. Weather proof case stove enameled block with screwed type inner bezel of ABS plastic and glycerin filled.
(vii) No. of contacts	2 NO + 2 NC
(viii) Type of contact	Adjustable throughout the range.
(ix) Degree of protection	IP. 65

7.21 Solenoid valve (to be provided with isolating valve)


Type	2/2 way Diaphragm type pilot operated
Diaphragm molded	synthetic rubber
Body	Forged brass / SS
Pressure	0.5 to 10 kg/cm ²
Protection Class	IP 65

7.22 Flow Switch (to be provided with isolating valves)

(i) Body	Forged steel
(ii) Extension Rod/wire	SS-304
(iii) Sleeve and Sleeve pipe	SS-304
(iv) Cover	Die cast aluminum
(v) Max. working pressure	10 kg/sq.cm
(vi) Repeatability	± 0.5%
(vii) No. of contacts	2 NO + 2 NC
(viii) Type of contact	Adjustable throughout the range.
(ix) Protection class	IP – 65

7.23 Level Switch

(i) Type	RF Capacitance Type
(ii) Probe	SS – 316

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(iii) Wire rope	SS – 316
(iv) Spring Housing Spring and sleeve pipe	SS – 316
(iv) Cover	Cast Aluminum
(v) No. of Contacts	2 NO + 2 NC
(vi) Type of Contact	Adjustable throughout the range.
(viii) Protection class	IP – 65


7.24 Level gauges

(i) Type	Float type mechanical gauge with arrow scale
(ii) Accuracy	(+/-)1% of full scale range
(iii) Material of construction	
(iv) Float & Guide wire	316 SS
(v) Elbows	Suitable grade of SS
(vi) Housing	Mild Steel
(vii) Cable fastener	SS 304

7.25 Additional Instrumentation

Additional points which will be monitored by the PLC may include, but are not limited to, the following:

- Metal detector status
- Pulley bearing temperature
- Pulley bearing vibration
- Brake disk temperature
- Brake caliper pad wear
- Gear reducer vibration
- Gear reducer lube oil temperature
- Gear reducer lube oil level
- Motor power
- Motor status-on
- Motor status-off

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- Motor winding temperature
- Motor bearing temperature
- Brake assembly control fault
- Brake assembly pressure fault
- Brake assembly emergency power supply
- Belt Tension
- Dust Collector Status
- Dust Collector Pressure Drop
- PLC Status



7.21 Closed Circuit Television (CCTV)

A complete CCTV system (Cameras unit, License, Software , Network switches , LIU , Media convertor , HMI, NVR, Storage, all hardware, console , Installation , interface with viewing monitor in Ammonia Urea Control room etc. to full fill tender requirement) shall be envisaged for this package area. All of the machines like Stacker, Stacker-Reclaimers etc. will have internal CCTV cameras and CCTV monitor system for the operator to view the process. These inputs will be shared with the Ammonia Urea Control room through the optical fibre cable network and the composite trailing cable arrangement. Laying of OFC cables shall be in bidders scope. Overall plot plan elsewhere attached with Tender to be referred by Bidder for determining distances and proposing cable routings. All cabling , laying with installation hardware is in bidder's scope.

Apart from the above, cameras will be located in the switchyard, Substations, control rooms, security gates and truck loading systems etc. for monitoring the operations.

One viewing monitor is planned to be provided in the Ammonia Urea Control room to facilitate the operator to view the stockpile from any one of the cameras or all cameras at the same time.

Bidder to note that number of cameras/ NVR must be sufficient to enable the purpose of round the clock monitoring and surveillance of the proposed **ROM COAL/PETCOKE/LIMESTONE HANDLING unit**. Minimum cameras shall be 8 Nos. , however the exact no. of CCTV camera shall be decided during detail engineering based on actual plant layout. Bidder to consider CCTV system in all respect to connect minimum 12 cameras.

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7.21 Communication system

Internal telephone communication system will be provided for easy and fast communication between. The main control of the system will be installed in the Ammonia Urea control room.

The EPABX system will be modern and user friendly with the following features

- 1.) The EPABX will have ISDN/IP support feature, suitable for 60 extensions and scalable for higher number of extensions with remote maintenance support.
- 2.) The EPABX will have provision for connecting 8 trunk lines.
- 3.) The EPABX will have provision for connecting 60 extensions, 8 Digital and 52 Analog.
- 4) One PC based operator console will be provided at a selected location. The operator console will also have one Lightweight Duo headset with flexible boom.
- 5.) 8 Nos. of extensions are considered with Digital phone instrument, with 2 line display.
- 6.) For all other extensions, entry level analog phone without display feature will be provided.
- 7.) The EPABX will have battery backup for 1 Hours duration, with conventional lead acid type batteries.
- 8.) The EPABX will have standard accessories like Exchange side Main Distribution frame and Field side MDF.
- 9.) The interconnection between the exchange and other buildings is planned through paired communication cables, planned to be laid through PVC pipes for protection.
- 10.) The system will be designed, supplied, installed and commissioned in line with the relevant IS standards.
- 11.) The system will be provided with suitable earthing arrangement, as per the design requirement.
- 12.) The exact no. of Digital phone instrument to be considered shall be decided during detail engineering.

8.0 PLANT MONITORING AND CONTROL

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In order to have better supervision, operation and control of the COAL/PETCOKE/LIMESTONE HANDLING, microprocessor based programmable logic controller (DMR-PLC) suitable for industrial control system has been envisaged. The PLC shall have the facilities for remote monitoring and sequential control, including local operation of individual equipment, audio and visual fault annunciation, normal status display, signalling, data logging, data display and printing etc. with appropriate liability of management reporting.

The scope of work included in this bid consists of design, supply, erection and commissioning of micro-processor based monitoring and control system with suitable printing and display devices and associated software for providing real time remote monitoring and sequential control of the COAL/PETCOKE/LIMESTONE HANDLING, including local operation of individual equipment for inspection/repair and maintenance. The system shall be provided with audio and visual fault annunciation, normal status display etc. For the purpose of efficient working, COAL/PETCOKE/LIMESTONE HANDLING shall be divided into (no.) zones for Integrated Control system for the entire plant, from where it shall be possible to control the entire plant.


PLC Hardware and Software

The PLC hardware and accessories used will be reliable, robust and selected for heavy duty operations. Redundancy for PLC CPU, IOs and power supply shall be provided. A primary and backup HMI server is required. Ladder diagrams or similar programs are to be used for the application program.

All analogue and digital inputs / outputs (I/O) shall be individually isolated, digital I/O and shall be individually fused for protection. Digital Input modules shall be of 16 channels & 16 channels digital outputs at 24V DC. Analogue modules shall be capable of 4 or 6 or 8 isolated channels analogue inputs or analogue outputs at level signal level off 4 - 20mA @24VDC. The I/O modules must be the type that can be pulled or replaced while the rack is still under power (RIUP) without disrupting any of the programmed software and damaging any of the control system hardware.

9.0 GENERAL SYSTEM REQUIREMENTS

The system/equipment shall be capable of working satisfactorily to the guaranteed performance under dust laden atmospheric conditions having an ambient temperature of

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surrounding up to 50 degree and relative humidity up to 95%. The system design shall be such that in case of addition / modification of various equipment in the COAL/PETCOKE/LIMESTONE HANDLING Package, the system can be extended easily for monitoring and control of additional equipment. The software shall be such that by reconfiguration at site the system shall be able to accommodate the modification. Any equipment/sub-system specifically not covered shall deemed to be included to make system complete.

The system shall have the following facilities:

- a) Real time automatic centralised control (starting and stopping) from control room for all equipment in accordance with a pre-determined sequence (both for starting and stopping) for normal operation of the plant so as to ensure safe and efficient operation of entire plant.
- b) Stopping of any equipment from the control station located near the drive of respective equipment under all conditions including emergency.
- c) Stopping of conveyors in case of emergency by Pull Cord Switches, Belt Sway Switches, and zero speed switches, etc provided along the conveyors.
- d) Starting and stopping of any desired equipment independently from local control stations located near the respective motors/drives for maintenance/ repair/ testing by selecting remote/local mode of operation through a suitable command provided in the control panel of control room.
- e) Sounding audio alarm/warning system prior to starting of the plant for information to plant personnel/maintenance staff to keep a safe distance from equipment under operation.
- f) Continuous status monitoring of all equipment e.g. conveyors, apron feeders, plough feeders, tripper conveyors, motorised flap gates, main transformers, circuit breakers etc. In addition to status monitoring, monitoring of other parameters like overload, single phasing, earth leakage, belt sway, belt speed, lubrication system, bearing temperature, noise level, vibrations, level of coal in bunker and silo, etc.
- g) Colour visual display units with functional key boards to allow the operator in control room to observe status of operation of various equipment, alarms, fault annunciation, mimic display on VDUs and to select the various displays on VDUs pertaining to inspection of state of readiness of control circuits prior to equipment to be started.

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- h) Dedicated keys on key board of control panel of control room for selecting Remote/Local modes of operation and issue commands for starting/stopping drives in sequential/individual mode.
- i) Preparation of Management information reports.
- j) Starting/stopping of Equipment which is not under sequence control from the site.

PLC CONTROL SYSTEM

9.1 General

The operation and control of ROM COAL/PETCOKE/LIMESTONE HANDLING Plant shall be through PLC based Control system.- The system shall be microprocessor based programmable logic control (PLC) with fault tolerant redundant processors based on DMR/TMR/QUAD technology.

The PLC will be used to provide protection and controls for the entire plant.

Following minimum functions are provided on the OS (Operator station):

1. Area wise display of the plant.
2. Operation of the plant from the OS.
3. The schematics will be having dynamic parameters like valve open / close and motor running/ fault indications

The Control system shall perform any of the following functions for safety of the plant from control room.

- Total Shut Down
- Unit Shut Down

It will perform the following functions also:

Data Display
 Process Control
 Process and system alarms
 Logging
 Real Time trends & Historical trend
 Dynamic Graphics
 Report Generation (shift, daily, weekly, monthly and on demand)
 System diagnostics

The following shall be adhered to while selecting the DMR system

- a) Redundant CPU's shall be applied.

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- b) If a CPU fails, the other(s) shall continue to operate. Single CPU operation system to be certified to operate without any time limitation of faulty CPU repair.
- c) Dual Redundant buses shall be applied.
- d) All closed loop shall be Redundant
- e) Redundant communication interfaces shall be supplied.
- f) Redundant Power supplies (at least three in parallel) shall be supplied.
- g) In the event of a failure of a fault tolerant component, power supply or other function, of the system shall change over to "single mode" operation without causing nuisance trips and also generate alarm on Operator and Engineering console.
- h) In case of failure of complete processor system, i.e., system outputs shall take fail safe state automatically unless otherwise specified.

Operator interface for critical trips shall be mosaic display with illuminated push button for trip, reset, inactivation etc. and LED indication for each element of trip & actions.



The operator will be informed about a trip situation by a warning sound (to be different from the audible signal from the alarm system), and a LED display will clearly inform about the alarms in trip position. The first up alarm will flash.

Scan time shall be maximum 250 msec. CPU loading shall not exceed 50%, Bus Communication modules, Power Supply and I/O cards shall have 100% redundancy and fail safe certification.

System Redundancy

Following system redundancy shall be available as a minimum.

- | | |
|---|-----|
| 1. Controller
(CPU for control, I/O communication,
network communication) | 1:1 |
| 2. Communication Bus | 1:1 |
| 3. I/O communication modules with CPU
(I/O bus between CPU and I/O
with all necessary hardware) | 1:1 |
| 4. Main data highway | 1:1 |
| 5. Communication Cards | 1:1 |
| 6. System Device | 1:1 |

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- 7. Power supply (Power supply for all CPUs, I/O power supply modules) 1:3
- 8. History 1:1
- 9. Modbus/Serial interface 1:1

10. OPC server: OPC server, If applicable shall have RAID-5 configuration with firewall.

11. System server (for server based PLC): Redundant (1:1 redundancy)

However, lamp drive cards, supporting mosaic need not be redundant also. Active isolator/barriers need not be certified for fail safe operation.

The operator can bypass trip alarm inputs, which may be necessary in abnormal situations. A lamp shall indicate that the trip alarm is inactivated. The operator will be warned by sound and fast flash if the inactivated circuit goes in alarm status.

Display colours shall be in accordance with the following:

- Alarm and Trip (safety operations) : Red
- Pre-alarm for trip (safety operations) : Orange
- Indication for by pass of trip (safety operations) : Red
- Equipment in operation (alarms and pilot lights) : White
- Ready (standby of equipment) : Green

The mosaic panels shall be mounted on auxiliary consoles of PLC operating console.

Consumables like printer paper, cartridges, fuses etc shall be supplied along with the PLC control system for a minimum period of one year duration.

Loading philosophy (with 20% installed spares and 20% future expansion).

- Control Processor 50%
- Communication Processor 50%
- Communication Bus 50%

9.2 PLC requirements

- a) All systems' all cards shall be supplied with ISA G3 level or equivalent coating for

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environmental protections.

b) ISOLATIONS

Analog I/Os to Field : Galvanic Isolation through safety barriers

Analog I/Os Module : Channel to Channel Galvanic Isolation

If individual channel to channel isolation is not available with system vendor, then only Isolation shall be provided in a group of 4 channels as per system vendor design.

Digital Input to Field : barriers + optical isolators on cards

Digital Output to Field : Interposing relays + smart barriers for monitoring purpose

c) PANELS:

All panels shall be either 1200 mm (wide) x 800 mm (depth) x 2100 mm (height) or as a special case 600 mm(wide) x 800 mm (depth) x 2100 mm (height), RITTAL make, with 100 mm black powder coated metal base frame and with colour shedding of RAL7032 (Siemens Grey) and removable gland plates at bottom only. This applies to all types of instrument panels to be used in the whole project like various PDB, Electrical / Instrument panels, Third party device panels, etc.

d) All A/D converters of system I/O cards shall have resolution of min. 13 bits and all D/A converters of system I/O cards shall have resolution of min. 10 bits

e) There shall be 20% installed spares minimum 1, installed and wired capacity for I/O cards of each category in DCS, including all peripheral termination modules, prefab cables, Relays, Safety barriers, etc

f) All marshalling and system panels shall have minimum 20 % wired spare capacity for future expansion (should be possible with the same wiring philosophy.)

g) I/O cards' Channel density shall not exceed the following limits:

Analog Input	8 Channels
Analog Output	8 Channels
Digital Input	16 Channels
Digital Output	16 Channels

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- h) Maintenance override switches (MOS) shall be soft type. One hardkey shall be provided in Auxiliary console for the Activation of the MOS.

Process override switches (POS) shall be soft type.

- i) Auxiliary Hardwired console

Auxiliary consoles shall be provided for high priority discrete hardwired safety functions, which shall be manually operated. The console shall be installed adjacent the operator station console, near 22" TFT/LED color monitors in the control room. The console shall be equipped with, Mushroom top Emergency push buttons for emergency shut-down action only. All Emergency stop and manual start/stop push buttons shall drive an interposing relay located at IRC. For all critical electricals drives (list will be discussed separately during detailed engineering), the spare contact of final DO command from PLC going to MCC, must be connected as DI into PLC and configured in SOE for confirmation of command to MCC from PLC.

All trip parameters shall have override switches and their output status lamp on console.

- j) All interlock and control transmitters shall be separate right from field junction box to marshalling panels
- k) Those parameters, which are directly or indirectly tripping the plant or may cause production loss, shall be wired with 2 out of 3 transmitter trip voting interlock in PLC. There shall be three separate analog input channels in three different cards. AI cards shall be used for this purpose in system. Same thing is applicable to Digital inputs also.

9.3 System Cabinets

9.3.1 Interlock Marshalling Cabinet

Marshalling cabinet(s) are foreseen for both incoming to Interlock system and outgoing from Inter ('from' and 'to' field) termination. The interlock marshalling cabinet(s) shall also accommodate the repeater power supplies for the field transmitters, galvanic isolators for all inputs, trip amplifiers, output relays etc.

The termination strips shall be arranged or grouped for inputs/outputs 24VDC, 115VAC, etc. both for inputs as well as outputs.

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The terminals shall be of the Wago/weidmuller/Phoniex /Klippon make screwless, cage clamp type, single tier design (double tier design shall be avoided). Terminal stack for each unit shall be supplied with approx. 20% extra terminal points as spare/future provision in addition to the existing inputs and outputs.

Physical separation between the terminal stacks/points shall be maintained for the intrinsically safe and normal termination. Also the termination area shall be physically separated from the electronics area there by sealing the latter from dust ingress.

9.3.2 Sequence of event (SOE)

Bidder shall provide the Sequence of event recorder function, with a time resolution not above the machine scanning time. This information shall be available, for archiving, filtering and visualization operations to the dedicated SOE workstation, located on the consoles of Engineering room in CR, to aid in diagnosis and recognise the first cause of plant or equipment shut-down.

Sizing of the system bulk memory capacity shall be done considering for SOE activities a rate of 5000 events/day (shall be finalised during detail engineering).


9.3.3 System Clock

The PLC control system clock shall have facility for synchronising with a Main plant DCS through hardwire DI signal. Bidder shall consider Ethernet port/TCIP for synchronising to Master GPS clock. Additional hardwired or communication connections / networks between PLC/DCS control system and Main plant DCS shall be consider by the bidder. Please refer area plot plan elsewhere attached with the Tender for finalising distance and cable route upto Main plant DCS (AMMONIA UREA CONTROL ROOM)

9.3.5 Power Supply

All instrumentation shall be fed by an Uninterruptible Power Supply (UPS) system.

An uninterrupted Supply to PLC system shall be provided to the power distribution cabinet of PLC system at 115VAC +/- 10%, 50Hz +/- 3%. UPS feeders from ACDB to DCS/PLC loads shall be redundant whereas UPS feeders for Non-Control system loads shall Non-redundant, The Contractor shall prepare a list Non-Control system UPS load requirement.

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115 VAC UPS Power supply feeder failure alarm before PDB shall be provided in PLC by using double pole MCB in PDB. One contact of these MCBs shall be wired to PLC for alarm purpose. Single point Power supply shall be provided at Main Control Room / SS, all cable supply & laying, termination, any work related execution of this package shall be in bidder scope.

In case rectification to DC is involved, rectifiers shall be dual redundant and both shall be 'hot' (on line) so that failure of one rectifier will not cause a system trip. Provision shall be included in the system to annunciate the rectifier/DC power supply failure.

24V DC power supply

- i) 24 VDC power supply required for interrogation voltage, solenoid valve supply, lamp, pushbutton, etc and for other packages shall be supplied by contractor using dual redundant Bulk Power Supply (BPS).
- ii) Each redundant bulk power supply shall be sized for maximum 50% loading of its capacity in normal time; the maximum loading is to be 70% of its capacity of BPS.
- iii) All bulk power supply (BPS) shall be provided with surge protection capability. BPS shall also provide with cooling fans and with fan failure alarm indications in DCS/PLC system.
- iv) Each BPS shall be provided with Mosfet based redundancy with auto-current balancing and equal loading on both PS.
- v) Power supply & redundancy module shall be same make .
- vi) Current output (4 to 20 mA) shall be available from the power supply unit and the same shall be wired to DCS/PLC for Power supply health monitoring and indication from all BPS.

Philosophy of power isolation and over load protection (switch fuse units) or only over load protection shall be extended upto individual card level, while designing the system, so that, minor card failures can be localised for easy rectification. Also this will avoid major down time on the system.

Earthing /Grounding bus bars for terminating shields of the cables shall be provided on the cabinet.

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Power supply (For all DCS/PLC and Vendor Packages): All BPS Failures shall be connected to DCS/PLC as a separate DI signal. All Diode O rings Failures shall be connected to DCS/PLC as a separate DI signal. All power feed Modules shall be connected to DCS/PLC as a Separate DI signal. All MCB healthiness feedback shall be connected to the DCS/PLC as a Separate DI signal. Silver/Cu/humidity/temperature monitoring shall be with 2 nos. of C/R with indication in DCS/PLC.

Healthiness of BPS/MOSFET O ring must have LED indications for indicating the healthiness of the module locally. 115 V AC and 24 V DC supplies must have current and voltage transducer wired to PLC.

9.3.6 Annunciator

The Annunciator display stations will consists of:

- LED Lamps
- Split type architecture with lamps and electronics separate
- All connections with interlock system cabinet and interlock marshalling cabinet shall be through plug in connectors.
- About 20% spare capacity shall be there
- All switches and status lights indicated below shall be an integral part of Display Modules.
- Supply shall include mounting accessories and about 20% of unassembled extra LED lamps

9.3.7 Precision & Accuracy



The isolator, repeater modules/trip amplifiers for analog inputs shall have a total accuracy of less than 0.2% of full span for the measurement circuit.

The accuracy and stability for thermocouple trip amplifiers, if applicable, shall be +/- 0.5%.

9.3.8 PLC Spare Philosophy:

Installed Spares	I/O Level	20%
	Marshalling	20%
Spare Space	I/O Level	20%
	Processor	50%
	Marshalling	20%

10.0 MISCELLANEOUS COMPONENTS

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The selection of those components that are not specifically covered in the foregoing clauses of this specification is left to the discretion of the BIDDER, subject to OWNER'S approval and being of good quality and suitable for use in typically severe industrial and mining applications.

11.0 LOCAL CONTROL PANELS

All local panels under the scope of package vendor shall follow the minimum specifications listed below:

- 11.1 Panels shall be suitable for acidic environment. All field mounted panels shall be of FRP material only. Sealings of the panel will be Silicone/EPDM or better, which will be freeze tested during detailed engineering.
- 11.2 Panel shall be free standing close cabinets, constructed in sections of min. 1000 mm wide. The panel construction shall be welded or bolted frame construction with upright and additional framing in modular construction. The panel front sheet thickness shall be min. 3 mm. The front of panel shall be stiffened where necessary with profiles tack welded to the rear. Top, sides and doors can be made out of 1.6 mm thick plate.
- 11.3 The panels shall have environmental protection conforming to IP 55 min.
- 11.4 Instrument air shall be provided for purging of local panels.
- 11.5 Panel face, sides and doors shall be sand blasted and cleaned before primer and two coats of paints are applied. The colour of paint shall be bright grey. The final surface shall be semi mat, free from blemishes and paint runs.
- 11.6 115V A.C. +/- 10%, +/- 3% Hz power at one point to the local panel shall be provided by the client. Any other voltage level if required preferably 24 V, DC, the same shall be arranged by the vendor. Redundant rectifier units shall be provided for the generation of d.c. by the vendor.
- 11.7 Earthing lugs for both power and system earthing shall be provided by the vendor.
- 11.8 The wiring shall preferably be contained in polymer ducts. Instrument safe wiring shall be laid separately from others. The colour of IS wiring shall be light blue.

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- 11.9 Wago/weidmuller/Phoniex /Klippon type cage clamp type terminals shall be used for cable termination and wiring. 20% terminals shall be kept as spares in each terminal strip and box. Terminals shall be spring loaded with screws, single tier in general.
- 11.10 Gland plates shall be provided along with cable glands (ex. proof wherever required) in each panel for cable termination.
- 11.11 A miniature circuit breaker shall be provided for each power supply with DI contact wired to system.
- 11.12 All panels shall be provided with vibration dampening pads.
- 11.13 Each panel section shall be provided with illumination level of 300 Lux min.
- 11.14 Each Control panel shall be provided with set of cooling fans to maintain and protect the installed Control system.
- 11.15 Name plate/labels shall be provided for each panel mounted instruments, equipments and accessories mounted in the front or rear of the panel.
- 11.16 Purged panels shall be provided with purge fail alarm. Purge fail trip shall be provided with a bypass switch.
- 11.17 The local panel must have power segregation at all levels. There shall be clear segregation and isolation of power supplies for all the local panels (115 VAC / /24 VDC).

12.0 PNEUMATIC TRANSMISSION

12.1 Output Signal

Output signal from all pneumatic transmitters shall be 0.2-1kg/cm²g.

12.2 Pneumatic Receiver Instruments

Pneumatic receiver instruments shall have receiver elements design for 0.2-1 kg/cm²g input signal.

12.3 Pneumatic Transmission Tubing

Pneumatic transmission tubing for local transmission shall be ½" or ¼" OD stainless steel tubing with SS316 fittings (inch).

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12.4 Instrument Air

Instrument air required is available at 6.5 kg/cm²g and max. 70 degree C. However, the air pressure can be down to 4.5 kg/cm²g for remote consumers. Design pressure is 10 kg/cm²g. Dew point is -40 degree C at line pressure.

Air Distribution Headers shall be as SS 304.

13.0 ERECTION , INSTALLATION & COMMISSIOING

The bidder shall be responsible for the installation, calibration & testing, commissioning of the complete instrumentation and controls as defined in this specification as minimum. All the instruments & systems installed by the bidder as per scope subject to inspection, checking, calibration & testing to prove their operational fitness. Testing & calibration shall be done by the bidder, if required , all the required tools, tackles, calibration instruments, qualified skilled manpower for conducting these tests shall be provided by the bidder.

Testing & calibration may be witnessed by representative Client/PMC and/or manufacturer's representative.


LETTER WRITING : LETTER WRITING FOR ALPHA-NUMERIC TAGGING (WITH SYNTHETIC ENAMEL). :- Letter writing of different sizes on Instrument Panels/misc. Instruments/ Equipments with synthetic enamel paints (Asian/ Jonson & Nicolson/ Berger /Nerolac Make) suitable for a temp. of 100 degree Celsius for writing of letters, figures etc. Job includes cleaning of surface on panels/instruments/misc. instruments etc. All complete with labour and materials as per drawings, specifications, Name plate schedule and directions of Engineer-in-Charge. (Supply of paints is in contractor scope).

14.0 GENERAL REQUIREMENTS OF INSTRUMENTATION

14.1 INSTRUMENT LOCATION

14.1.1 The location of instruments, control valves. Including junction boxes shall permit easy access from grade, permanent platforms or stairways for operation, inspection and maintenance.

14.1.2 The use of portable ladder or mobile platform shall be limited to access root valves, thermowells and line mounted flow meters.

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14.1.3 Locations shall be decided to minimize the possibility of damage from passing or falling objects and the possibility of tripping hazard or obstruct on walkway.

14.2 INSTRUMENT CABLE

14.2.1 Overhead Runs

Instrument main cable tray from field junction boxes to main control building or local control room shall generally be laid in aboveground cable tray with protection cover. Tray protection cover shall be provided only for the tray on top of tray layer.

Instrument branched cable runs from junction box or local panel to each instrument in the field shall also be routed aboveground and supported with trays, steel angles and channels.

Perforated FRP cable trays/cable ducts shall generally be used for main cable trays. Single pair cables from instrument to junction box and branch cable tray shall be through perforated FRP cable trays.

The scope of supply includes perforated FRP cable trays, & accessories such as Bends, tees, crosses, reducers & connector plates and accessories like bolts, nuts (SS316) etc.


For Signal 900mm/ 600mm/300mm tray and for power 600mm/ 300 mm tray to be considered or shall be discussed during detail Engineering.

Cable tray segregation shall be based on the voltage level. Cable tray shall be supported at every 3M. 20% spare to be considered in the cable tray filling.

Instrumentation cables that form part of intrinsic safe (IS) circuits, if any, Shall be segregated from other instrument signal cables.

Instrument power supply (AC) cables shall not run in the same tray of instrument signal cables. Cable tray shall be dedicated for laying instrument power cables separately from the signal cable tray.

Alternatively, cable ducts of suitable size shall also be considered for main cables. When common cable ducts are used for running both power and signal cables, necessary air gap partition shall be used to segregate the cables.

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14.3 CABLES

The primary insulation material shall be XLPE (cross linked polyethylene) for all types of multi pair cables as per IEC-60502/60840/IS-7098 Part-1. Inner and outer jacket shall be made of extruded flame retardant 90 deg C PVC to IS-5831

All cables shall be FRLS zero halogen as per standard IEC 332-3 Part 3 Cat. A. Fire resistance cables whenever specified shall be as per me 331 Cat. A.

The insulation grade shall be 600 V/1100 V as a minimum arid shall meet insulation resistance, voltage and spark test requirements as per BS-5308 Part-2

All cables shall be armoured. Armour over inner jacket shall be of galvanised steel wire/flat as per IS-1554 part I / IEC 502. All the cores of single pair or multi-pair shall be twisted and numbers of twist shall not be less than 10 per metre.


For signal and control cables, inner jacket colour shall be black. Outer jacket colour shall be light blue, for intrinsically safe application and black for others. For thermocouple extension cables the inner and outer jacket colour shall be as per IS-8784.

L/R ratio of adjacent cores shall not exceed 40 μ H/ohm for cables with 1.5 mm² conductor Electrical Properties of Cables shall be in line with EN50288-7:2005

Contractor shall ensure a minimum of 20% of quantity of each type of cables supplied as spare including any special cable and in each multipair cables 20% pairs shall be kept as spare.

14.3.1 Instrument Signal Cable

- a) Single pair shielded signal/alarm cables shall be used between all field instruments including switches and junction boxes/local control panels.
- b) Triad cable shall be used between GDs/RTDs to JB/Transmitter respectively.
- b) Multipair individually and overall shielded signal/alarm cables shall be used between junction boxes/local control panels and control room.
- c) The single pair/triad cables shall be 1.5 mm² conductor size made of annealed electrolytic copper conductor of 7 strands with each strand of 0.53 mm diameter. Multipair cables with 1.5 mm² conductor size shall have 7 strands of annealed electrolytic grade copper conductor with each strand of 0.3 mm diameter. Multi triad cable or multi pair cable with 1.5 mm² conductor shall have 7 strand with each

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strand of 0.53 mm diameter. Colour of core insulation shall be black blue in pair and black, blue and brown in a triad.

- d) Shield shall be aluminium backed mylar/polyester tape bonded together with the metallic side down helically applied with either side having 25% overlap and 100% coverage. The minimum shield thickness shall be 0.05 mm in case of single pair/triad and 0.075 mm in case of multipair/triad cable.
- e) Drain wire shall be provided for individual pair and overall shield which shall be 0.5 mm² multi stranded bare tinned annealed copper conductor. The drain wire shall be in continuous contact with aluminium side of the shield.
- f) All multi pair cables shall have 6 pair/12 pairs only while multitriad cable shall have 6 triads/8/12 triads only. Size for multipair cable will be 1.5mm² with drain and overlap as above.

14.3.2 Cables and Multicore Cables for Solenoids etc.

Cables and multicore cables for such items as solenoid valves and flame detectors shall normally have a conductor size of 2.5 mm². However, conductor sizes for power cables shall be co-ordinated with the Electrical Group to avoid too many different cable types.

Signals (4-20 mA or switch 'contact): 6/12 pair individually and over all shielded (screened) and armoured, twisted, 1.5 mm² conductor.

14.3.3 Thermocouple Extension Wires

- a) Single pair shielded thermocouple extension cables shall be used between thermocouple head and junction boxes transmitters/ local control panel mounted instruments.
- b) Multipair individually and overall shielded thermocouple extension cables shall be used between junction boxes and main control room mounted devices.
- c) The type of thermocouple extension cables shall be compatible with thermocouple used. In addition the colour coding of the primary insulation shall be as per ANSI.
- d) The cable shall have 16 AWG and 18 AWG solid conductors for single and multipairs respectively.

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- e) All thermocouple extension cable shall be matched and calibrated in accordance with MC-96.1.
- f) Shield shall be aluminium backed by mylar/polyester tape bonded together helically applied with the metallic side down with either side having 25% overlap and 100 % surface. Minimum shield thickness shall be 0.05 mm for single pair and 0.075 mm for multipair cable. Drain wire shall be 0.5-mm² multi-strand bare tinned annealed copper conductor. The drain wire shall be in continuous contact with the aluminium side of the shield.
- g) Inductance shall not exceed 4mH/Km.
- h) All multi-pair cables shall have 6 pairs/12 pairs only.

14.3.4 Power supply Cables

All power supply cables shall be as per IS-1554 Part I and shall have copper conductors. Minimum conductor size shall be 2.5 mm². The cables shall be PVC insulated and armoured. The higher size conductors shall be used in case of long distance power cable where voltage drops more than 3 volts than required supply.

Any other special cable required for instruments that should also be supplied as per requirements. CONTRACTOR shall ensure that these cables are armoured type and shall meet all other requirements.

14.3.5 OPTICAL FIBER CABLE

The Optical Fiber Cable (OFC) used shall conform to the following specification as a minimum:

- a) The OFC shall be CSTA (corrugated steel tape armored, electrolytically chrome plated low carbon steel) armored cable.
- b) The OFC shall have FRP strength member, loose tubes for single mode optical fibers filled with moisture resistant jelly, moisture barrier of polymer coated Aluminum tape or water swellable tape, inner sheath of HDPE and outer sheath of PVC.
- c) Optical fibers shall be single mode fibers compliant to ITU-TG.652 and fibers colours shall correspond to IEC 793-2 and 304. Optical fibers shall be coated with UV cured double acrylic resin. It should not have any reaction with cladding or core material. The coating should provide maximum resistance to micro-bending & abrasion and

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ensure mechanical & optical strength. The coating shall be easily stripped with mechanical tools.

- d) The number of fibers in the OFC shall be decided depending upon the requirement with 8 fibers as a minimum.
- e) The cabled fiber attenuation shall be -S 0.37 dB/km for 13] 0 nm wavelength range and 0.22 dB/km for 1550 nm wavelength range.
- f) The tensile performance shall be as per . IEC 60794-1-2 E1 and with tensile load of $9.81 \times 2.5 W$ (Where W= mass of 1 km of cable in Kg)Newton Or 2670 N whichever is higher.

14.4 JUNCTION BOX

- a) Junction box material shall be of FRP with thickness of 4mm. All junction box shall be weatherproof to IP-65 as well as flameproof / as per area classification .
- b) In all JBs, cable entries shall be from Bottom only. Further after commissioning, all JB's should be covered with Aluminum tapes at its periphery to prevent water ingress.

In general a junction box shall contain only signal of same class. The signal class is categorized as following type:

- i) Signal Level
 - Analog
 - Digital
 - T/C
 - Solenoid Valve
 - Instrument Power
 - Gas Detectors
- ii) Type of protection
 - Non IS, Ex d
 - IS
- c) All JB extra entries shall be plugged with SS316 plug. Each junction box shall be provided with 2 multi-cable entries from the bottom of the junction box with one plugged. All Cable entry shall be at the bottom only, and not from side or top.

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- d) All spare cable cores shall be terminated in the Junction box, at the marshalling panel end and wired through spare barriers / isolators or relays (as the case may be) right upto the corresponding spare channel of I/O module.
- e) All spares hole of JB's, T/C head etc to be plugged with metallic plugs. The metallic plugs, Junction box hinges, Handle, DIN rail, Allen screws shall be SS 316 material of construction.
- f) For ease of identification shutdown JB's shall be colored should be marked with RED.
- g) Cable glands shall be provided with Cables shrouds. 20% spare terminals shall be supplied in each junction box.

14.5 CABLE GLANDS


- a) Contractor shall supply all cable glands required for glanding the above mentioned cables both at field instrument and local control panel side, junction boxes side and at control room side.
- b) All cables glands shall be of SS316 ex-proof and they shall be double compression type suitable for armoured cables. Glands shall be in line with Area classification
- c) Flame proof glands wherever required 'shall be supplied .

14.6 INSTRUMENT VALVES AND MANIFOLDS

- a) Contractor shall supply instrument valves (miniature type) and valve manifolds wherever required.
- b) Body rating shall be as per piping class or better. All valves and manifolds shall be forged type only.
- c) Valve body and trim material shall be SS 316L unless otherwise specified. Superior trim material shall be selected as requirement by process conditions. Packing material in general shall be of PTFE



14.7 INSTRUMENT IMPULSE LINES

- a) In general ½" OD annealed seamless SS 316 tubing shall be used in preference to piping.

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- b) Tubing standard shall be used upto 600 # only where the same is required as per job specification. For rating above 600 # and hydrogen/lethal service, only piping standard shall be used. The tubing shall be 1/2" OD tube with all fittings suitable for the same. Valves used shall be threaded. At the first isolation / root valve end suitable pipe tag to tubing conversion fittings shall be used. For remote installation suitable unions / couplings shall be used.
- c) Piping standard shall be used for all installation where specified in job specification. For rating upto 600#, the connection to the transmitters shall be with a male connector and tubing 1/2" OD. For rating higher than 600 #, no tubing shall be used. The connection to the transmitters shall be with 1/2" piping with flanges in between piping standard, all pipes shall be 1/2" NB unless higher sizes required to meet the "requirements, with all fittings suitable for the piping. All the joints shall be welded or flanged as required. For instrument end connection i.e root valve of orifices and other items, level gauges vent and "drain connection, seal welding shall be provided. For non diaphragm seal instruments and instruments where provided with threaded connection, no welding is required at instrument end
- d) All instruments shall be provided with isolation, drain and/ or vent valves with vent/drain end duly capped. This isolation valve shall be SS304 GATE type. It shall be in addition to the first isolation /root valve provided on the pipe or vessel at instrument take off.
- f) For diaphragm seal type instruments, spacer ring with vent and drain connection along with vent / drain valve with end capped.
- g) Contractor shall supply flareless compression type of tube fitting and of three piece construction with design similar to Swagelok/Parker Hannifen etc.
- h) Socket-weld type forged pipe fittings of suitable material and rating shall be supplied for pipe fittings. The minimum rating shall be 3000 #. Weld neck fittings shall be used where socket weld type are not allowed by piping class.
- i) All pipe fittings shall be according to piping material specification as per piping class of the pipe on which instrument is connected. In case of vessel/equipment / reactor, PMS of equivalent piping class shall be considered.

14.8 INSTRUMENT AIR SUPPLY DISTRIBUTION

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Instrument air headers, pipes and distributors shall be of S.S 304. Instrument air manifold shall be used for supplying instrument air to control valves and other instruments. These shall be with 10 nos. of tappings and be with ½” NPT (F), SS 304 valves. From the nearby air manifold, instrument air shall be supplied to the control valves. For the purpose, all tubing shall be used shall be of SS316, ¼”, 1/2” OD, seamless tubes, laid in perforated aluminium trays. All intermediate fittings shall be double compression, SS316 MOC, Swaglok /Parker make only.

Instrument air shall be provided at one point at battery limit. Package vendor has to develop air distribution scheme.

14.9 MCT Blocks

Cable entry to main control room shall be through MCT blocks.

Entry into the Panels in the control room shall be through bottom mounted MCT blocks.

Bidder shall provide minimum 8+8x6 MCT frame along with multi-dia blocks with peeling of arrangement and centre plug, with wedge, lubricant, stay plate. Bidder shall provide at least 20% installed spares with mult-dia blocks with peeling of arrangement and centre plug. (Qty of frame shall be submitted by the bidder during bidding stage with typical cable arrangement).


14.10 PROTECTION AND PAINTING

All exposed carbon steel parts to be painted shall be thoroughly cleaned from inside and outside to remove scale rust, dirt and other foreign materials by wire brushing / sand blasting as applicable. Minimum acceptable standard in case of power tool cleaning shall be St. 3 and in case of blast cleaning shall be SA 2. as per Swedish standard SIS 055900-1967.

- Non – ferrous materials. Austenitic stainless steels, plastic or plastic coated materials.
- Insulated surfaces of equipment and pre-painted items shall need not be painted.
- Stainless steel surfaces, both inside and outside. Shall be pickled and passivated.
- Machined and bearing surfaces shall be protected with varnish or thick coat of grease.

Depending on the environment the following primer and finish coats shall be applied:

S. No.	Environment	Description	Minimum Requirements
1	Normal – Industrial	Primer	2 coats of Red oxide
			Zinc phosphate each 30-35 microns thick

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S. No.	Environment	Description	Minimum Requirements
		Finish Coat	2 coats of synthetic enamel, each 25 microns (min.) thick.
2	Corrosive – Industrial	Primer	2 coats of epoxy zinc chromate, Each 35 microns (min.) thick.
		Finish Coat	2 coats of epoxy high build paint, each 100 microns (min.) thick.
3	Coastal and Marine	Primer	2 coats of high build chlorinated rubber. Zinc phosphate, each 50 microns (min.) thick.
		Finish Coat	2 coats of chlorinated rubber coat paint. Each 35 microns (min.) thick.
			(Any values refer to dry film thickness).

Colour Band shall be provided on loading arm as per Product colour code at site.

14.11 PACKAGING AND IDENTIFICATION

All packaging shall be done in such a manner as to reduce the volume. The equipment shall be dismantled into major components suitable for shipment. All assemblies shall be properly match marked for site erection.

Attachments, spare parts of the equipment and small items shall be packed separately in wooden cases. Each item shall be appropriately tagged with identification of main equipment. Item denomination and reference number of the respective assembly drawing.

Detailed packing list in waterproof envelope shall be inserted in the package together with equipment. Each equipment shall have an identification plate giving salient equipment data, make, year of manufacture. Equipment number, name of manufacturer, etc.

15.0 Training

Supplier shall train Clients' maintenance engineers as well as operations staff in his works at Vendors Center of Excellence. The training imparted shall be by qualified and experienced staff available. It shall be exhaustive and aimed at making clients' maintenance & operations staff self reliant for most of the day to day applications. For training, supplier shall make available as close a model of the system with all the representative nodes, as the actual system to be installed. It is envisaged that following be covered in the training:

Operating Staff Training

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Operating courses include all aspects involved in operating the Control System from operator interface. This shall include operation under normal and abnormal conditions as may result from minor or major system malfunctions such that the trainee can take the appropriate remedial actions. The training shall include but not be limited to the following:

- Overview of the system
- Control philosophy
- User interfaces
- Messages and alarms
- Operator commands
- Generation of reports
- Predictable events and expected operator action

Engineering staff training

Software Design courses shall be provided which would train the Employer's Maintenance and Design staff to be able to identify and remedy software faults, upgrade and implement data and software changes, generate/develop new software for the purpose of improving the system and production of revised or new displays. The training shall include but not be limited to the following:

- Overview of the system architecture, hardware and software
- Software design and organisation
- Database structure, generation and modification
- Generation and modification of the VDU screen
- Customization of report/chart/graph format
- Assembly, compilation, linking, editing, debugging, distributing, testing and integration of program modules

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Bidder to consider FAT/SAT for the offered system in his scope of supply. FAT/SAT procedure.

FAT – Factory Acceptance Test

FAT is inspection for verification that all equipment and devices function properly with integrity.

Prior to notification of FAT to Client/Purchaser, all the involved contractual documentation shall be completed and all the cabinets, equipment and components of Control system shall be assembled and installed in one area at one time.

Bidder shall demonstrate all the functions of the PLC working properly in FAT. Each test shall be carried out on the procedure reviewed and accepted by Client/PMC/Purchaser after submitting Manufacturing Internal Test Certificate.

FAT certificate shall be issued by bidder at the successful end of the test activities. All the hardware and software failures and problems shall be documented. All the failures and problems shall be resolved before shipment to site, All series of actions shall be taken in accordance with the FAT procedure.

FAT will start with Visual Inspection including the following activities as minimum;

- Quantity of all the cabinets, equipment and components.
- Installation of all the cabinets, equipment and components.
- Tagging of all the cabinets, equipment and components.
- Wiring of all the cabinets, equipment and components.

Once Visual Inspection has been successfully completed, Hardware Testing shall start including the following activities as minimum;

Power-On

- Redundancy of Power Supply on failure
- Diagnostics of the main equipment
- Redundancy of the main equipment on failure
- Redundancy of network on failure
- 100% I/O Accuracy Check at 5 point (0%, 50%,100%,50% and 0%) for all the hardwired points (sample check may be allowed if 100% I/O Accuracy has been checked Manufacturer Internal Test)

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Once Hardware Testing has been successfully completed, Software Testing shall start including the following activities as minimum;

- I/O Database implementation
- Graphic implementation
- Control implementation
- Logic and sequence implementation
- Historian implementation
- SER implementation
- AMS implementation

SITE ACCEPTANCE TEST (SAT)

SAT is inspection for checking that all the conditions are good after installation at site.

Prior to notice of SAT to Client/Purchaser, bidder shall submit all the "As-Shipped" documentation incorporating all the FAT correction.

Prior to start SAT, all the cabinets, equipment and components of PLC shall be installed in proper location as designed.



Bidder shall demonstrate all the function of PLC working properly in SAT. Each test shall be carried out on the procedure and its criteria reviewed and accepted by Client/Purchaser.

Test certificate shall be issued by bidder at the successful end of the test activities. All the hardware and software failures and problems shall be documented.

SAT shall be identical to FAT but at reduced amount to check hardware without any damage, installations completed properly and interface working properly. bidder shall provide special tools and test equipments.

17.0 GENERAL TERMS OF EXECUTION

In case of any contradiction between these parts/sections of the specification, more stringent specification to be followed. Also where there are discrepancies in text and drawings, the data given in the text is to be followed. All the equipment and facilities are to be supplied by the successful bidder within the estimated time period. All equipment / systems shall be designed, fabricated and selected as per relevant Indian standard / international standards and latest engineering practices and necessary inspections / test certificates shall be submitted along with equipment supply to certify the quality and genuineness of critical components and capacity and other technical parameters of the equipment/systems.

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18.0 DOCUMENTATION

SI.No	Description	With Bid (Y/N)	For Review/ Approval	For Information	Final/ Approved/ As-built
	INSTRUMENTATION				
1	Drawing & document schedule		Y		Y
2	Instrument Index			Y	
3	Instrument sizing calculations (control valves, safety valves & flow elements)			Y	
4	Utility requirements			Y	
5	Level sketches			Y	
6	Material Requisition		Y		Y
7	Purchase Requisition			Y	
8	Vendor Drawings			Y	
9	Functional Schematic			Y	
10	Logic Diagrams as per ISA 75.2			Y	
11	Instrument loop drawings			Y	
12	Control room layout		Y		Y
13	Layout of equipment inside control room		Y		Y
14	Power supply distribution		Y		Y
15	Wiring diagram for panels			Y	
16	Configuration diagram		Y		Y
17	I/O assignment		Y		Y

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18	DCS graphics, report/log formats & other DCS docs.		Y		Y
19	Instrument duct / tray layout			Y	
20	Instrument cable schedule			Y	
21	Instrument location plans			Y	
22	Instrument installation drawings			Y	
23	Bill of material for installation items			Y	
24	Spare part list for :				
	a. Mandatory Spares			Y	
	b. Start up & commissioning			Y	
25	Inspection & test procedures			Y	
26	Complete catalogues with part list for all vendor supplied instruments, control etc.			Y	
27	Installation, operation & maintenance manuals			Y	
28	As Built Drawings			Y	
29	System Architecture			Y	
30	Instrument Control Philosophy			Y	


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ANNEXURE -1

INSTRUMENT ACCURACIES

The instrument reference accuracies shall be as per the table below. Accuracy of the Instruments shall be minimum as follows. Custody Transfer accuracies shall be as defined in the ITB in terms of rms.

Type of Instrument	Accuracy
Process Gas Analyzer – All type	+/- 2% FS
Conductivity , pH meters	+/- 0.5 % of Reading
Belt weighers	+/- 0.5 % of range
SILICA Analyzer	+/-0.5 ppb or better
Sodium Analyzer	±5 % of reading or better
Chlorine Analyzer	± 2 % or better
Differential pressure & Pressure transmitter - SMART	± 0.050% of span within TD ratio of 1: 100 or better
Diaphragm seal transmitter & Pressure transmitter - SMART	± 0.050% of span within TD ratio of 1: 100 or better
Variable area type flow meter with transmitter	± 2.0% FS Note (1)
Vortex flow meter	± 0.7 % FS
Positive displacement flow meter	
- Raw material and Product	± 0.2% FS
- Others	± 0.5% FS
- Turbine meter or Mass flow meter	
- Raw material and Product	± 0.2% FS
- Others	± 0.5% FS
- Magnetic type flow meter	± 0.5% FS
- Mass flow meter (Coriolis Type)	± 0.1% FS
- Ultrasonic type flow meter	± 0.5% FS
- Ultrasonic type flow meter(5 – path)	± 0.1% FS
Orifice plate : Normal Application	+/- 2% of flow rate
Orifice plate : Special Application	+/- 1.5% of flow rate
Venturi	+/- 1 % of flow rate
- Displacement type level indicator	± 1.0% FS
- Displacement type level transmitter	± 0.2% FS (Smart)
- Tank gauge (Custody Transfer)	± 1 mm with +/- 1 mm resolution
- Servo type tank gauge	± 2 mm (up to 20 m height)

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- Radar type tank gauge	± 1 mm or better for custody transfer ± 5 mm or better for normal application
	± 0.2% of span within TD ratio of 1: 100
- Pressure gauge	± 1.0% of span for Bourdon type , 1.5% for diaphragm
- Temperature Transmitter	± 0.15 % of calibrated span for RTD & T/C
- Filled system/Bimetallic	± 1.0% FS
- Small size pressure gauge	± 3.0% FS
- Draft gauge	± 3.0% FS
- Receiver gauge	± 1.5% FS
- Thermocouple & Resistance Bulb	Applicable Codes/Standards

Note: 1. Vendor's standard accuracy is applied to local indicator type

- Remarks:**
1. Accuracy of instrument and special articles except for the above mentioned instrument shall be in accordance with the applicable codes/standards, or Vendor's standards as approved by Purchaser.
 2. FS: Full scale.
 3. Overall rangeability of transmitter except for draft range shall be 1: 100. Draft range transmitter rangeability shall be 1: 30 for the accuracy indicated above.
 4. Accuracy for the instruments shall be % of reading and shall be supplied with wet calibration certification.

ANNEXURE -2

Field instrument connections shall be as follows.

Instrument Type	Process / Vessel Connection	Instrumentation Connections
DP Flow Instruments	½" NPT (M)	½" NPT
External Displacer on Vessel (Min. Rating ANSI 300#)	2" Flanged	2" Flanged
Internal Displacer (Min. Rating ANSI 300#)	4" Flanged	4" Flanged
External Ball Float on Vessel (Min. Rating ANSI 300#)	2" Flanged	2" Flanged
Internal Ball Float (Min. Rating ANSI 300#)	4" Flanged	4" flanged
Magnetic Level Gauge (Min. Rating ANSI 300#)	2" Flanged	2" Flanged

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D/P Level	½" NPT (M)	½" NPT
D/P Level with Remote Seal Diaphragm (Min. Rating ANSI 300#)	3" Flanged	3" Flanged
D/P Level Direct Vessel Mounted (Min. Rating ANSI 300#)	3" Flanged	3" Flanged
RADAR – Direct Mount on vessel (Min. Rating ANSI 300#)	3" flanged	3" flanged
GW RADAR – Side/Side Chamber Mounted on vessel (Min. Rating ANSI 300#)	2" flanged	2" flanged
Internal GWR on Equipment (Min. Rating ANSI 300#)	4" Flanged	4" flanged
Special Level Instrument on Equipment (Capacitance/ Ultrasonic/R.F.Probe)	2" flanged	2" flanged
Tank Level Instruments (Servo) on Atmospheric tank/ Pressurized Equipment	6" flanged	6" flanged
Tank Level Instruments (Radar) on Atmospheric tank clean service / Pressurized Equipment	8" flanged	8" flanged
Tank Level Instruments (Radar) on Atmospheric tank viscous service / Pressurized Equipment	24" flanged	24" flanged
Tank Level Instruments (Capacitance/ Ultrasonic/R.F.Probe) on Atmospheric tank / Pressurized Equipment	2" flanged	2" flanged
Pressure Instruments	½" NPT (M)	½" NPT
Press.Gauge	½" NPT (M)	½" NPT
Pressure with diaphragm seal, (Min. Rating ANSI 300#)	3" Flanged	3" Flanged
Pressure Instruments on Vessel	1 ½" Flanged	½" NPT
Pressure Instruments on Standpipe	¾" SW/BW/Flanged	½" NPT
Chemical Seal pressure Instrument gauge on Vessel	1 ½" Flanged	½" NPT
Diaphragm Seal pressure Instrument gauge on Vessel	1.5" Flanged	1.5" Flanged
Thermowell (Min. Rating ANSI 300#)	1 ½" Flanged	1 ½" Flanged
Multipoint Temperature Element for Tanks	2" Flanged / 3" Flanged	2" Flanged / 3" Flanged
Standpipe	3" Flanged	-

Note:-

- a. There shall be a separate tapping for each of the instruments on any pipeline/vessel. No multiple instruments from one tapping is acceptable (for example PG and PT from single pipe

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line tapping with single or double mechanical isolation valves are not acceptable). However, as an exception to this, three transmitters on clean gas services from one orifice (with two pairs of tapping) is acceptable, where multiple (2 out of 3, etc.) transmitters are to be installed.

- b. All type of instrument tapping flange rating shall be minimum ANSI 300#, irrespective of minimum design pressure. However for pressure rating of 600# class and above, RTJ flange shall be used. At few locations, double isolation valves shall be used as per table given below.

INSTALLATION	PRESSURE TAPPINGS	LEVEL TAPPINGS	FLOW ELEMENTS	CONTROL VALVE
<u>RATING</u>				
300 #	SINGLE	SINGLE	SINGLE	SINGLE
600 #	DOUBLE	DOUBLE	DOUBLE	SINGLE
900 # / 1500 # / 2500 #	DOUBLE	DOUBLE	DOUBLE	SINGLE

Annexure - 3

SYSTEM CONFIGURATION

PLC/DCS system package

1 Nos Operator Stations (RAID 1)with ,22” TFT, COLOR, LED type dual stacked monitors to be place in CR consoles

1 Nos Operator Stations (RAID 1) with ,22” TFT, COLOR, LED type dual stacked monitors to be place in Ammonia Urea control room for Viewing Purpose.

1 Nos OS cum ES with SOE ,dual stacked (RAID 5) dual personality, 22” TFT, COLOR, LED type to be placed in CR consoles

1 no. of Membrane Operator’s Keyboard and 1 no. of QWERTY engineer’s keyboards with mouse with each operator station

1 No. Annunciator with LED lamps with split type architecture

1 No Auxiliary Console

All USB ports must be blocked and the system must have latest anti-virus.



Printers

1 Nos A3 Black and White HP make Laser printer

(All printers shall have wireless facility)

Required furniture of GODREJ make shall be considered in the offer.

All the license required for OS,ES shall be in Bidder’s scope.

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Annexure - 4

OPERATOR STATION SUB-SYSTEM

* Model No. Note-1

A. General Requirement

1	Number of Operator Consoles	Three
2	Inter-changeability between operator consoles	Required
3	On-line system diagnostics on Console Monitor	Required at Module level
4	On-line configuration change	Required
5	Console configuration	Single

B. OPERATOR CONSOLE


1	Console's basic electronics	Individual electronics for each monitor
	µp Type	64 bit
	µp Manufacturer/ model	<u>Note-1</u>
	Memory size /Cache size	16_GB (Vendor to check <u>the suitability of memory size</u>)
2	Type of Database	Functionally Separate

Database Storage Devices:

Sr. No.	ITEM MODEL No.	FUNCTION	REDUNDANCY (Refer Note)	REMARK
1.	HDD	<u>Note-1</u>	REQUIRED	1 TB Min
2.	Combo drive	<u>Note-1</u>	REQUIRED	
3.	Vendor recommended	<u>Note-1</u>	REQUIRED	
4.			REQUIRED	

(Note1 : Full Redundancy is required if Centralized global database is provided)

STORAGE DEVICES ARE APPLICABLE IN EACH OPERATOR STATION.

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3 Number of Devices (per console)

S. No	TYPE OF DEVICE	Description OF DEVICES REQUIRED	NO. OF DEVICES	REMARKS
1.	MONITOR	22" TFT, COLOR, LED type dual stacked monitors	1 per console	
2.	KEYBOARD SETS	1 no. of Membrane Operator's Keyboard and 1 no. of QWERTY engineer's keyboards with mouse.	1 per console	
3.	ALARM & EVENT, LOG A4 PRINTER	1 Nos A4 Heavy duty Colour –HP make	1	
7.	DVD DRIVE		1 per console	
8.	ANNUNCIATOR KEYBOARD	1 No. Annunciator with LED lamps with split type architecture	1	

4 Inter-changeability between Monitors Required

5 Spare memory requirement Min. 40%

6. Keyboard Set

a) Keyboard Security against unauthorized access Required with Key-lock

Note: Key-lock Password shall be provided for each operator console.

b) Maximum number of keystrokes for accessing views as per standard display hierarchy:

S.No.	TYPE OF VIEW	REQUIRED	OFFERED	REMARKS
1.	GROUP VIEW	TWO		
2.	LOOP VIEW	THREE		
3.	LOOP IN ALARM	TWO		

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4.	GRAPHICS VIEW	TWO		
----	---------------	-----	--	--

- c) Assignable function keys for single keystroke access Required
- d) Number of Assignable function keys per Monitor 64
- 7 a) Number of devices for cursor control Two/Monitor
- b) Devices for cursor control Keyboard **[X]** Mouse **[X]**
- 8 Monitors and Displays
- a) Size of Monitor 22" diagonal
- b) Type of Monitor TFT LED
- c) Surface Treatment Hard Coating anti Glare
- d) Length of tag number (characters) 16 alphanumeric
- e) Length of description (characters) 24 alphanumeric
- f) Display update rate 2 s
- g) Dynamic graphics Required
- h) Multi Window Capability Required
- i) Control through dynamic graphics Required
- j) Screen displays and Call-up time

S.No.	TYPE OF DISPLAY	REQUIRED	CALL-UP TIME(S)*	REMARKS
1.	OVERVIEW	YES		
2.	GROUP DISPLAY	YES		
3.	LOOP DISPLAY	YES		
4.	DYNAMIC GRAPHICS	YES		
5.	REAL-TIME TREND	YES		
6.	HISTORIC TREND	YES		
7.	ALARM SUMMARY	YES		
8.	ALARM HISTORY	YES		
9.	CONFIGURATION	YES		
10.	DIAGNOSTIC	YES		

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k) Display Hierarchy

S. No.	DESCRIPTION	REQUIREMENT	SYSTEM CAPABILITY	REMARKS
1.	NO. OF OVERVIEW PAGES	AS REQD.		
2.	NO. OF GROUPS/OVERVIEW	AS REQD.		
3.	NO. OF LOOPS / GROUP	8		
4.	NO. OF GRAPHIC PAGES	AS REQD.		
5.	NO. OF POINT IN ALARM SUMMARY	AS REQD.		
6.	NO. OF POINTS IN ALARM HISTORY	AS REQD.		
7.	NO. OF TRENDS PER DISPLAYS	AS REQD.		
8.	NO. OF MULTI-TREND DISPLAYS	AS REQD.		
9.	OTHERS	AS REQD.		

- l) Multi Windowing facility Required
Note: Opening of more than four windows on the same Monitor shall be restricted by the system .
- m) Trending functions: Each Operator Console shall be capable of trending all analog points.
- n) Real-time trend
Number of parameters Required for ALL TAGS
- o) Historical trend
Number of parameters Required for ALL TAGS
Time period 30 Days
- 9) Logging Function
a) Number of tags to be logged Required for ALL TAGS
b) Number of log reports:
Alarm History per shift

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- Event logging
- Hourly logs
- Shiftly logs
- Daily logs
- Weekly logs
- Shutdown report
- Trip initiated log
- Others (Note)

Note: Other log reports as required shall be furnished during execution stage.



- c) Log formats User definable
- 10 System boot-up from Engineer console
- 11 Auto boot-up on power On Required
- 12 Storage disks
 - a) Type of storage disk HDD Optical (DVD)
 - b) Number of disks and capacity

Sl. No.	TYPE OF DISC	NUMBER (MINIMUM)	MEMORY CAPACITY PER DISK	REMARKS
1	HDD	One Per Monitor	AS per latest configuration	1 TB Min
2.	OPTICAL	One Per Monitor	AS per latest configuration	
3.	Other			

13 Any other feature available as a standard:

- a) _____
- b) _____

- 14 CPU Loading 60 %
- 15 Memory Utilization 60 %
- 16 Operating System Latest must have validation with the system
- 17 Antivirus/Network SecurityRequired


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OPERATOR CUM ENGINEERING STATION SUB-SYSTEM

• Model No. _____

1. Number of Engineering cum Operator Station One
2. Number of Monitors per Engg. Station One
3. Type of electronics Individual per Monitor
 µP type 64 bit
 Memory size NOTE-1
 Model No. NOTE-1
4. Number of engineering keyboards One per Monitor
5. Number of Operation keyboards One per Monitor
6. Functional Capability Same as operator station subsystem
7. Basic functions of Engineering Console
 - a) System configuration and reconfiguration
 - b) Group & multi-groups alarm inhibiting
 - c) Plant views with/ without plant operation
 - d) Graphic page compilation
 - e) Setting/ resetting real-time clock
 - f) Loop tuning on selectable basis
 - g) System maintenance and diagnostics
8. Monitor specification As per operator station subsystem
9. Keyboard specification As per operator station subsystem
10. Data storage Devices and capacity

Sr. No.	TYPE OF DISC	NUMBER (MINIMUM)	MEMORY CAPACITY PER DISK	REMARKS
1	HDD	One	As per Latest configuration	1 TB Min
2.	DVD writer	One		
3.	OPTICAL(DVD)	One	As per Latest configuration	
5.	OTHER			

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11. Antivirus/Network Security Required

HARDWIRED CONSOLE

- Model No. ____ By vendor

1. One no. of Hardwired/Aux. console:
2. Instrument Located on Hardwired consoles: (AS REQUIRED)

INSTRUMENT TYPE	NUMBER REQUIRED ON HARDWIRED CONSOLE WITH	
		CONSIDERED BY VENDOR
ASSIGNABLE RECORDERS	N.A.	
HARDWIRED ANNUNCIATORS	AS REQUIRED	
INDICATING LAMPS	AS REQUIRED	
SWITCHES	AS REQUIRED	
PUSHBUTTONS	AS REQUIRED	
OTHERS	AS REQUIRED	

- 3 Power supply Alarm/Annunciator 115 V AC, 50 Hz [X]
- 4 Power supply for switches, lamps, pushbuttons etc. 24 V DC

ANNEXURE -5

Type of Signal	Inst to JB (1P,1T)		JB to CR (6P/12P/6T/8T/12T)		CR to MCC/MCC to CR (Multi-conductor cable)	
	Size *(mm2)	Type	* Size (mm2)	Type	Size (mm2)	Signal
AI	1.5	Signal	1.5	Signal	1.5	Signal
AO	1.5	Signal	1.5	Signal	1.5	Signal
DI	1.5	Signal	1.5	Signal	1.5	Signal
DO	1.5	Signal	1.5	Signal	1.5	Signal
RTD	1.5	Signal	1.5	Signal	1.5	Signal
TC	1.5	Signal	1.5	Signal	1.5	Signal
GD	1.5	Signal	1.5	Signal	-	-
SOV	2.5	Signal	2.5	Signal	-	-
POWER	2.5	Power	2.5	Power	2.5	Power
TC Extension cable	Special compensation cable between Element to transmitter					
RTD	Triad cable between					

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Extension cable	Element to transmitter of 1.5mm ²				
Analysers	1.5	Signal	1.5	Signal or serial communication as the case may be.	

***Note :** Above size is minimum. Further cable size may be increase based on voltage drop calculation.

Note:- The Tender has been prepared as per general tender type. Whatever type of instruments are not applicable shall not be used. Remaining tender terms prevail.

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INSPECTION AND TEST REQUIREMENTS FOR INSTRUMENTATION



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CONTENT

Sl. No.	DESCRIPTION
1.0	Inspection and Tests
1.1	General
1.2	Visual Inspection
1.3	Dimensional Inspection
1.4	Material Inspection
1.5	Non-Destructive Examination
1.6	Pressure Test
1.7	Pneumatic Test
1.8	Seat Leakage Test
1.9	Performance Test
1.10	Steam Test
1.11	Insulation Resistance Test
1.12	High-voltage Test

ATTACHMENT

Sl. No.	DESCRIPTION
Table-A	Table-A- Table of Inspection and Test Items

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1. INSPECTION AND TESTS



1.1 General

- 1.1.1 All instruments and system-oriented items shall undergo factory testing and inspection by authorized Third party representatives / Owner and PMC unless specified otherwise.
- 1.1.2 Wherever inspection at manufacturer's shop is waived because of any reason, the sub vendor's own testing reports shall be verified before despatch. In no case items shall be released without proper inspection verification.
- 1.1.3 The inspection and testing shall be carried out as per related specifications, international codes and practices/standards, approved documents and/or any other documents attached along with specifically suggesting testing to be carried out at manufacturer' works.
- 1.1.4 Items, for which 'Witness Inspection' is specifically exempted, manufacturer shall forward the test certificates as desired for review. The material shall be despatched only after obtaining written despatch clearance.
- 1.1.5 No system or system oriented item shall be despatched without integrated factory testing witnessed by representatives of / Third party inspector / Owner /PMC. The testing procedures shall be detailed out, based on testing requirements indicated in individual system specifications and shall be approved by Owner/ PMC. It must certify that the system is actually ready before calling the Owner/PMC for FAT. Also all the necessary documents and literature are to be submitted before calling for FAT.
- 1.1.6 Testing and inspection for all items shall be carried out as per approved factory testing procedures.
- 1.1.7 Performance specifications must be detailed out on each time which shall be verified by third party agency / by Owner / PMC during factory testing.
- 1.1.8 Acceptable criteria for Radiography and other NDT requirements for the instruments / instrument castings shall be inline with those specified in 'Piping Specifications' have been attached elsewhere in this package.
- 1.1.9 IBR certifications shall be provided by in the appropriate format duly signed by IBR authority or their authorised agency.
- 1.1.10 Verification of setpoint of rupture disc shall be part of witness inspection. Testing shall be carried out on the rupture disc, which are part of the actual rupture disc batch of manufacturer. This shall be in addition to the 3 numbers of spare rupture discs already indicated in the requirements. The testing, in general, shall be as per ASME section VIII.
- 1.1.11 Inspection and test items, witness inspection items for each kind of instrument at FAT (Factory acceptance test) shall be as shown in Table A.
- 1.1.12 Inspection and acceptance standards

Inspection and acceptance standards shall be as follows.

1.2 Visual Inspection

1.2.1 Conformation items

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1. Type and model
2. Tag no.
3. Rating
4. Range, Scale and symbol of unit
5. Set pressure and capacity of safety valves
6. Valve characteristics and CV value of control valves
7. Name of materials
8. Nameplate
9. Colour of painting
10. Die Marking (nominal size, material of flange and direction of flow)
11. Accessories
12. Quantity

1.2.2 Harmful defects

- Defect such as cracks, deformation and flaws shall not be found in the casting, forging and machined surface of the pressure rating part.
- Defect such as inside surface weld protrusion; lack of fusion and incomplete penetration shall not be found in welded places of pressure retaining part.

1.2.3 The instrument shall be in rugged design and assembly of all components within the enclosure fixed firmly to avoid loosening or falling-off of any parts.

1.2.4 Painting of instrument's surface shall be such that there is no defect or lack of uniformity.

1.3 Dimensional Inspection

- Main parts

Check and conform to the requirement of Purchaser's Spec, approved drawings or applicable code and standards.



1.4 Material Inspection

1.4.1 Mill test certificates

Manufacturer shall submit the mill test certificates for the following parts.

1. ANSI class 900 or above (ALL material used at the P.T. ratings)
2. The following parts made of steel for :
 - High temperature service (Alloy steel above C-Mo steel used at temperature of 400°C or over)
 - Low temperature service (Iron and steel material of design temperature bellow minus 11°C containing Al-killed steel)
 - Corrosion-resistant materials

- | | |
|--|---|
| I. Temperature detective parts | : <input checked="" type="checkbox"/> Flange and Thermowell |
| II. Orifice assembly | : <input checked="" type="checkbox"/> Flange |
| III. Venturi tube, Flow nozzle and Low-loss tube | : <input checked="" type="checkbox"/> Body |
| IV. Positive displacement flow meter and | : <input checked="" type="checkbox"/> Body, Strainer and |

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	Turbine meter		Straightner
V.	Area type flow meter	: <input checked="" type="checkbox"/>	Body and Flange
VI.	Displacement type liquid level meter	: <input checked="" type="checkbox"/>	Chamber and Flange
VII.	Glass Gauge	: <input checked="" type="checkbox"/>	Body and Flange
VIII.	Control valve	: <input checked="" type="checkbox"/>	Valve body, Bonnet, Plug, Seat and Vane
IX.	Safety valve	: <input checked="" type="checkbox"/>	Valve body, Nozzle and Disc
X.	Condensate pot	: <input checked="" type="checkbox"/>	Body
XI.	Gas eliminator	: <input checked="" type="checkbox"/>	Body

1.4.2 Material grade 316SS or 316L SS of stainless steel, Purchaser may require Vendor to carry out the qualitative analysis for molybdenum.

1.5 Non-Destructive Examination

1. Control valve and safety valve
Following Par. 1.5.2 and 1.5.3

2. Other instruments
Shall be carried out in accordance with manufacture's standards approved by Purchaser

1.5.1 Ultrasonic Examination

1. Forging material on Orifice flange and Flow nozzle
 ANSI class 900 or above

1.5.2 Radiography Examination

[] The pressure retaining casting parts

1. Applicable material and quantity (refer table VI)

- Welded parts : [] JIS Z 3104, Z 3106
 ASME VIII Division 1 uw-51 "Radiographic & Radioscopic Examination of Welded Joints"

2. Acceptant standards and grade

- Casting : [] JIS G 0581
 ASTM E 446-9 or 186-93



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Table VI Radiography Examination

Materials			Quantity
Casting	class 1500 or over	C-steel	One out of total quantity of the same type, size and rating for pressure retaining critical parts(a)
	class 900 or over	C-Mo steel	
	class 600 or over	Cr-Mo steel Stainless steel	
	class 300 or over	Al-killed steel 2.5 Ni steel 3.5 Ni steel	
Pressure retaining welded parts	class 1500 or over	C-steel C-Mo steel	One spot on each welded parts per same material and same welder. All welded crossing parts
	class 300 or over	Cr-Mo steel Stainless steel	
	class 150 or over	Al-killed steel 2.5 Ni steel 3.5 Ni steel	

- a. Following parts are Critical parts.
- Groove-welded parts of cast body
 - Flange neck and valve seat's vicinity of cast body
 - Other welded parts included in pressure retaining parts

Note: 1. In case of practical difficulty to perform Radiography Test, Manufacture shall notify Purchaser in advance, and for such case, magnetic particle or liquid penetrant examination may be used in accordance with Par. 1.5.3 with Purchaser's approval.

2. For the welded parts having nominal size of 1-1/2 in. or below, magnetic particle or liquid penetrant examination in Par. 1.5.3 may be used.

1.5.3 Magnetic Particle or Liquid Penetrant Examination

[X] For the pressure retaining parts



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Table VII Magnetic particle / Liquid penetrant examination

Materials			Quantity
Casting	class 900 or over	C-steel	20% of total quantity of the same type, size and rating for pressure retaining critical parts (a)
	class 600 or over	Cr-Mo steel Cr-Mo steel Stainless steel	
	class 150 or over	Al-killed steel 2.5 Ni steel 3.5 Ni steel	
Pressure retaining welded parts (b)	class 150 or over	All materials	20% of total welded parts

- a. Refer to Par. 1.5.2(1).
- b. Including butt groove-welded parts at site.

1.6 Pressure Test

1.6.1 Control Valve

1. Body and Bonnets

Hydrostatic test with Applicable codes and standards

2. Body of special type

Hydrostatic test

Test pressure and Hold time

1.5 times of max. Operating pressure / min. 2 kg/cm²

Minimum 5 minutes.

3. Permanent distortion or Leakage

shall not be found

1.6.2 Safety Valve or Safety Relief Valve

1. Pressure retaining parts



Hydrostatic test before assembling

i. Test pressure and Hold time

1.5 times of Max. Operating pressure / min. 2 kg/cm².

2.2 times of Max. Operating pressure.

Minimum 5 minutes.

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ii Distortion or leakage
 shall not be found

2. The out side parts of enclosed type
 Hydrostatic test after assembling

i. Test pressure and Hold time
 1.5 times. Nominal pressure of flange
 2.2 times. Nominal pressure of flange
 Minimum 5 minutes.

ii. Defects
 Shall not be found

3. Special type valves

Hydrostatic test with the manufacturer's standards approved by purchaser, where Par. 1.6.2(1) and (2) are not applicable

1.6.3 The pressure retaining parts of instrument

Hydrostatic test or Pneumatic test as per applicable codes and standard

I Test pressure and Hold time
 1.5 time of Max. Operating pressure / Min. 2 kg/cm²
 Min. 5 minutes

ii Permanent distortion or Leakage
 Shall not be found

If the above mentioned test is technically difficult, the test shall be carried out in accordance with the manufacturer's standards approved by purchaser.

1.7 Pneumatic Test

1.7.1 The pneumatic test for instrument

I Test pressure & Hold time
 Max. Operating Pressure. (Design press.)
 Minimum 5 minutes



ii Permanent distortion or Leakage
 Shall not be found

1.8 Seat Leakage Test

1.8.1 Control Valve

Allowable leakage valve / (code):

ANSI B16.104 (FCI 70-2)

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Unless other wise specified, butterfly valves shall not require the seat leakage test.

1.8.2 Safety valve

Seat leakage test (closing property) as follows.

1. Safety valve for Steam

i. Test pressure

90% of set pressure

ii. Leakage

Shall not be found

2. Safety valve for Gas

i. Test pressure

90% of set pressure

ii. Allowable leakage value (Refer Table – VIII)

Table VIII - Allowable leakage value of Safety valve

Type	Orifice Area (mm)	Number of Bubbles (min)	Leakage Value (cm ³ /min)
General	16.0 and less	40	11.80
	20.5 and over	20	5.90
Balance bellows	16.0 and less	50	14.75
	20.5 and over	30	8.85

3. Relief safety valves, Vacuum breakers and atmospheric valve

Manufacture's standard (approved by Purchaser)

1.9 Performance Test

For each instruments, the performance test shall be carried out in accordance with procedure approved by Client / PMC.



Acceptance standard shall be in accordance with applicable codes & standard, All specification, and manufacture's standard shall be approved by Client / PMC.

1.10 Steam Test

Steam test shall be performed as follows:

Valves used for steam service Temperature of 450°C or more, and the body ratings of class 600 and above.

After attaining the steady surface temperature same as temperature of the service with the pressure of service condition.

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In the case, when steam test has been performed and the report is submitted for the valve of same type, same bore size and material from the same lot, the steam test for the other valves may be omitted.

1. Leakage

- i. Body : [] Shall not be found
- ii. Seat : [] As per specified leakage value

2. Operation

[] To be smooth

After the steam test, the test of Par. 1.6 and Par. 1.8 shall be carried out.

1.11 Insulation Resistance Test

- 1. Power supply circuit & alarm circuit : 10M Ω or over (instrument panel: 3 M Ω or over/each panel)
- 2. Signal circuit : 5M Ω or more (instrument panel: 3 M Ω or More per panel)

The test shall be carried out in accordance with the applicable codes & Standards. Due to any technical constraint to measure, this test can be omitted

1.12 High-voltage Test

1. A-C power supply and alarm circuits

- i. Voltage level less than 250 V : [X] A-C 1500 V
- ii. Voltage level 250 V and above : [X] A-C 2E + 1000V

'E' is the rated voltage.

2. D-C power supply circuits : [X] A-C 500V

Test can be omitted in case of any technical constraint.

Table A : Table of Inspection and Test Items

Kind of Instrument	Inspection and Test Items										
	Visual insp.	Dimensional insp.	Material insp.	Non-destructive exam	Pressure test	Pneumatic test	Seat Leakage test	Performance test	Insulation resistance test	High voltage test	Steam test
1 Thermocouple	○●T	○●T	—	—	—	—	—	□●T	□●T	□●T	—
2 Resistance thermometer bulb	●T ○	●T ○	—	—	—	—	—	●T □	□●T	□●T	—
3 Compensating lead wire	○●T	○●T	—	—	—	—	—	□●T	□●T	□●T	—
4 Bimetallic thermometer	○●T	○●T	—	—	—	—	—	□●T	—	—	—
5 Gas or liquid-filled thermometer	○●T	○●T	—	—	—	—	—	●T □	—	—	—
6 Thermowell	○●T	○●T	○ □●T	○ □●T	○ □●T	—	—	—	—	—	—
7 Orifice plate	○●T	○ □●T	○●T	—	—	—	—	—	—	—	—
8 Orifice flange	○●T	○●T	○ □●T	○ □●T	—	—	—	—	—	—	—
9 Restriction orifice	○●T	○ □●T	○●T	—	—	—	—	—	—	—	—
10 Flow nozzle low-loss tube	○●T	○●T	○ □●T	○ □●T	○ □●T	—	—	—	—	—	—
11 Venturi tube	○●T	○●T	○ □●T	○ □●T	○ □●T	—	—	—	—	—	—
12 Positive displacement flow meter	●T ○	●T ○	●T ○ □	●T ○ □	●T ○ □	—	—	●S ○ □	●T ○ □	●T ○ □	—
13 Area type flow meter	○●T	○●T	○ □●T	○ □●T	○ □●T	—	—	○ □●T	○ □●T	○ □●T	—
14 Thermal mass flow meter	●T ○	●T ○	●T ○	—	●T ○ □	—	—	●S ○ □	●T ○ □	●T ○ □	—
15 Turbine meter	●T ○	●T ○	●T ○ □	●T ○ □	●T ○ □	—	—	●S ○ □	●T ○ □	●T ○ □	—
16 Differential pressure flow meter	●T ○	●T ○	—	—	●T ○ □	—	—	●T ○ □	●T ○ □	●T ○ □	—
17 Differential pressure transmitter	●T ○	●T ○	—	—	●T ○ □	—	—	●T ○ □	●T ○ □	●T ○ □	—
18 Magnetic flow meter	●T ○	●T ○	●T ○	●T ○ □	●T ○ □	—	—	●S ○ □	●T ○ □	●T ○ □	—
19 Bourdon gauge	○●T	○●T	—	—	○ □●T	—	—	○ □●T	—	—	—
20 Draft gauge	○●T	○●T	—	—	—	—	—	○ □●T	—	—	—
21 Differential pressure gauge	○●T	○●T	—	—	○ □●T	—	—	○ □●T	—	—	—
22 Pressure transmitter	○●T	○●T	—	—	○ □●T	—	—	○ □●T	○ □●T	○ □●T	—
23 Displacement type level indicator, controller	●T ○	●S ○ □	●T ○	●T ○	●S ○ □	—	—	●S ○ □	●S ○ □	●T ○ □	—
24 Chamber for displacement type level meter	○●T	○ □●T	○ □●T	○ □●T	○ □●T	—	—	—	—	—	—
25 Glass gauge	○●T	○ □●T	○ □●T	○ □●T	○ □	—	—	—	—	—	—



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Kind of Instrument	Inspection and Test Items										
	Visual insp.	Dimensional insp.	Material insp.	Non-destructive exam	Pressure test	Pneumatic test	Seat Leakage test	Performance test	Insulation resistance test	High voltage test	Steam test
26 Float type level meter,	●T ○	●S ○	●T ○ □	●T ○ □	●S ○ □	—	—	●S ○ □	●S ○ □	●T ○ □	—
27 Differential pressure type level meter	○●T	●T ○	●T ○	—	●T ○ □	—	—	●T ○ □	●T ○ □	●T ○ □	—
28 Purge type level meter	○●T	○●T	—	—	—	—	—	○ □●T	—	—	—
29 Capacitance type level meter	○●T	●T ○ □	●T ○	—	—	—	—	●T ○ □	●T ○ □	●T ○ □	—
30 Conductivity type level meter	○●T	●T ○	●T ○	—	—	—	—	●T ○ □	●T ○ □	●T ○ □	—
31 Conductivity type level meter	●T ○	●S ○	—	—	—	—	—	●S ○ □	●S ○ □	●T ○ □	—
32 Weight sounding type level meter	●T ○	●S ○	—	—	—	—	—	●S ○ □	●S ○ □	●T ○ □	—
33 Radiation type level meter	●T ○	●S ○	—	—	—	—	—	●S ○ □	●S ○ □	●T ○ □	—
34 Pneumatic type control valve	●T ○	●S ○	●T ○ □	○ □●T	●S ○ □	—	●S ○ □	●S ○ □	●T ○ □	●T ○ □	—
35 Hydraulic type control valve	●T ○	●S ○	●T ○ □	●T ○ □	●S ○ □	—	●S ○ □	●S ○ □	●T ○ □	●T ○ □	—
36 Motor-operated control valve	●T ○	●S ○	●T ○ □	●T ○ □	●S ○ □	—	●S ○ □	●S ○ □	●S ○ □	●S ○ □	—
37 Self-acting control valve	○●T	○●T	○ □●T	○ □●T	○ □●T	—	—	○ □●T	—	—	—
38 Indicator	○●T	○●T	—	—	—	—	—	○ □●T	○ □●T	○ □●T	—
39 Recorder unit	○●T	○●T	—	—	—	—	—	○ □●T	○ □●T	○ □●T	—
40 Controller unit	○●T	○●T	—	—	—	—	—	○ □●T	○ □●T	○ □●T	—
41 Integrator unit	○●T	○●T	—	—	—	—	—	○ □●T	○ □●T	○ □●T	—
42 Alarm setting unit	○●T	○●T	—	—	—	—	—	○ □●T	○ □●T	○ □●T	—
43 Computing unit	○●T	○●T	—	—	—	—	—	○ □●T	○ □●T	○ □●T	—
44 Converter unit	○●T	○●T	—	—	—	—	—	○ □●T	○ □●T	○ □●T	—
45 Limiter unit	○●T	○●T	—	—	—	—	—	○ □●T	○ □●T	○ □●T	—
46 Power source unit	○●T	○●T	—	—	—	—	—	○ □●T	○ □●T	○ □●T	—
47 Instrument panel	●T ○	●S ○	—	—	●T ○ □	●S ○ □	—	●S ○ □	●T ○ □	●T ○ □	—
48 Instrument desk	●T ○	●S ○	—	—	—	—	—	●S ○ □	●T ○ □	●T ○ □	—
49 Gauge board	●T ○	●S ○	—	—	●T ○ □	●S ○ □	—	●S ○ □	●T ○ □	●T ○ □	—
50 Safety valve	●T ○	●S ○ □	●T ○ □	●T ○ □	●T ○ □	—	●S ○ □	●S ○ □	—	—	—
51 Pilot operated safety relief	●T	●S	●T	●T	●T	—	●S	●S	—	—	—



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Kind of Instrument	Inspection and Test Items										
	Visual insp.	Dimensional insp.	Material insp.	Non-destructive exam	Pressure test	Pneumatic test	Seat Leakage test	Performance test	Insulation resistance test	High voltage test	Steam test
valve	○	○ □	○ □	○ □	○ □		○ □	○ □			
52 Vacuum breaker	●T ○	●S ○ □	●T ○ □	●T ○ □	●T ○ □	—	●S ○ □	●S ○ □	—	—	—
53 Atmospheric valve	●T ○	●S ○ □	●T ○ □	●T ○ □	●T ○ □	—	●S ○ □	●S ○ □	—	—	—
54 Gas chromatograph	●T ○	●T ○	—	—	—	●T ○ □	—	●S ○ □	●S ○ □	●T ○ □	—
55 Mass spectro-meter	●T ○	●T ○	—	—	—	●T ○ □	—	●S ○ □	●S ○ □	●T ○ □	—
56 Infrared type gas analyzer	●T ○	●T ○	—	—	—	●T ○ □	—	●S ○ □	●S ○ □	●T ○ □	—
57 Magnetic type gas analyzer	●T ○	●T ○	—	—	—	●T ○ □	—	●S ○ □	●S ○ □	●T ○ □	—
58 Thermal conductivity type analyzer	●T ○	●T ○	—	—	—	●T ○ □	—	●S ○ □	●S ○ □	●T ○ □	—
59 Combustion type gas analyzer	●T ○	●T ○ □	—	—	—	●T ○ □	—	●S ○ □	●S ○ □	●T ○ □	—
60 Density type gas analyzer	●T ○	●T ○	—	—	—	—	—	●S ○ □	●S ○ □	●T ○ □	—
61 Photo-electric type analyzer	●T ○	●T ○	—	—	—	—	—	●T ○ □	●T ○ □	●T ○ □	—
62 Moisture analyzer	○●T	●T ○	—	—	—	—	—	●T ○ □	●T ○ □	●T ○ □	—
63 pH meter	○●T	○●T	—	—	—	—	—	○ □●T	○ □●T	○ □●T	—
64 Turbidity analyzer Water quality analyzer	●T ○	●T ○	—	—	●T ○ □	—	—	●T ○ □	●T ○ □	●T ○ □	—
65 Density meter	○●T	○●T	—	—	○ □●T	—	—	○ □●T	○ □●T	○ □●T	—
66 Electric conductivity meter	○●T	○●T	—	—	○ □●T	—	—	○ □●T	○ □●T	○ □●T	—
67 Flame detector	●T ○	●T ○	—	—	—	—	—	●S ○ □	●S ○ □	●T ○ □	—
68. Mass Flow meter	●T ○	●T ○	●T ○ □	●T ○ □	●T ○ □	—	—	●S ○ □	●T ○ □	●T ○ □	—
69. Vortex Flow Meter	●T ○	●T ○	●T ○ □	●T ○ □	●T ○ □	—	—	●S ○ □	●T ○ □	●T ○ □	—
70 Gas detector	●T ○	●T ○	—	—	—	—	—	●S ○ □	●S ○ □	●T ○ □	—

- : Tested by Manufacturer.
- : Tested by manufacturer & witnessed by 3rd party inspector(TPI).
- : Manufacturer will submit Inspection & test records.
- T : Total Inspection by TPI.
- S : Sample inspection by TPI.(10% of total quantity of the same type & rating.

Notes: PMC/OWNER may witness any or all testing in stages during manufacturer or at final stage before shipment.

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SECTION:VI- 3.3

DESIGN PHILOSOPHY- ELECTRICAL

**PLANT : ROM COAL/PETCOKE/LIMESTONE HANDLING
FROM RAILWAY SIDING TO STORAGE YARD**

**PROJECT : INTEGRATED COAL BASED FERTILISER
COMPLEX, AT TALCHER, ANGUL DISTRICT,
ODISHA (INDIA)**

0	14.03.23	14.03.23	Issued for Enquiry	RK	SKB	SKB
REV	REV DATE	EFF DATE	PURPOSE	PREPD	REVWD	APPD

	ROM COAL/PETCOKE/LIMESTONE HANDLING FROM RAILWAY SIDING TO STORAGE YARD TALCHER FERTILIZERS LIMITED DESIGN PHILOSOPHY – ELECTRICAL	PC183/E/4018/SecVI-3.3	0	
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SECTION NUMBER	DESCRIPTION
1.0	Scope
2.0	Basis of Design
3.0	Deleted
4.0	System Details and Utilization Voltages
5.0	Power Supply and Distribution
6.0	Sub Station
7.0	Protection & Metering
8.0	Control and Monitoring
9.0	Equipment Specification
10.0	Cabling
11.0	Illumination System
12.0	Earthing and Lightning Protection
13.0	Capacitor Banks
14.0	Fire Detection and Alarm System
15.0	Coal/Petcoke/Limestone Handling System
16.0	Structure
17.0	Spares
18.0	Vendor's Services
19.0	Testing & Inspection
20.0	Documentation
21.0	Tools & Tackles
22.0	Review of Drawings & Documents by Owner/ Consultant
23.0	Training
24.0	Vendor List
25.0	Installation, Testing and Commissioning
26.0	Testing of Installation after Erection
27.0	Quality Assurance
28.0	Coordination with Other Contractors
Annexure-I	Illumination Levels

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LIST OF ATTACHMENTS

Technical Specification No.	Description
PC183-TS-0802	Uninterrupted Power Supply System
PC183-TS-0803	Power Transformers
PC183-TS-0804	Neutral Earthing Resistor
PC183-TS-0805	Medium Voltage Switch Boards
PC183-TS-0806	High Voltage Switch Boards
PC183-TS-0807	Bus Duct
PC183-TS-0808	Sheet Steel Distribution Boards
PC183-TS-0809	Lighting Sub Distribution Boards
PC183-TS-0810	Induction Motors
PC183-TS-0811	Interlocking Sw. Socket and Plug
PC183-TS-0813	Battery Charger
PC183-TS-0814	Battery
PC183-TS-0815	Cables
PC183-TS-0816	Prefabricated Ladder Type Cable Racks
PC183-TS-0817	Local Control Stations
PC183-TS-0818	Junction Box
PC183-TS-0819	Electricals for Over Head Cranes and Hoists
PC183-TS-0820A	Variable Frequency AC Drives (High Voltage)
PC183-TS-0820B	Variable Frequency AC Drives (Medium Voltage)
PC183-TS-0821	Communication & Fire Alarm Cables
PC183-TS-0822	Capacitor Bank & Associated Equipment
PC183-TS-0826	Fire Detection and Alarm System
PC183-TS-0829	Auxiliary Service Transformer
--	Conceptual SLD - 11 kV Switchboard (Drg. No. PC183-1225)
--	Conceptual SLD - 3.3 kV Switchboard (Drg. No. PC183-1226)
--	Conceptual SLD - 415V Switchboard (Drg. No. PC183-1227)
	Reference Architectural Drawing – ECMS (Drg. No. PC183-1228)

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<u>Electrical Sketches</u>	<u>Description</u>
PC183-PDS:E 113	Foundation Details of 11/0.433kV Transformers
PC183-PDS:E 114	Foundation Details of 11/3.45kV Transformers
PC183-PDS:E 115	Typical Details of Transformer Room Door
PC183-PDS:E 116	Sump Pit for Transformer Oil
PC183-PDS:E 119	Typical Foundation Arrangement for Panels in Sub-Station
PC183-PDS:E 120	Typical Foundation Details for HT/LT Circuit Breaker Panels
PC183-PDS:E 207	Details of Bracket Arm for Street Lighting Pole
PC183-PDS:E 208	Installation Arrangement Area Lighting Fixtures
PC183-PDS:E 210	Junction Box for Street Lighting Pole
PC183-PDS:E 213	Typical Street Lighting Pole
PC183-PDS:E 464	Schematic Diagram Panic Light
PC183-PDS:E 510	Details of Concrete Cable Trench
PC183-PDS:E 511	Cable Rack Arrangement in Trenches
PC183-PDS:E 516	Typical Arrangement of Cables buried in slit
PC183-PDS:E 530	Pre-Fabricated Cable Tray Straight Run
PC183-PDS:E 531	Pre-Fabricated Cable Tray Horizontal Tee
PC183-PDS:E 532	Pre-Fabricated Cable Tray Horizontal Cross
PC183-PDS:E 533	Pre-Fabricated Cable Tray 900 Horizontal Bends
PC183-PDS:E 534	Pre-Fabricated Cable Tray 900 Vertical Bend Bending Rad. 1000 mm
PC183-PDS:E 535	Pre-Fabricated Cable Tray 900 Vertical Bend Bending Radius 600 mm
PC183-PDS:E 536	Pre-Fabricated Cable Tray Coupling Arrangement
PC183-PDS:E 537	Pre-Fabricated Cable Tray Fixing Arrangement
PC183-PDS:E 538	Pre-Fabricated Cable Tray Reducing Coupler Plate
PC183-PDS:E 601	General Notes on Earthing and Lightning Protection
PC183-PDS:E 602	Earthing Conductor Details
PC183-PDS:E 603	Arrangement of Connections of Earth Conductors
PC183-PDS:E 604	Typical Details of Connection in Earth Pit
PC183-PDS:E 605	Earth Pit Details
PC183-PDS:E 606	Typical Arrangement of Earthing for Motor and Start Stop Push Button
PC183-PDS:E 611	GI/Al Accessories for Earth Electrode
PC183-PDS:E 613	Earthing of storage tank & vessel
PC183-PDS:E 615	GI Earth Bus
PC183-PDS:E 617	Typical Arrangement for Neutral and Equipment Earthing

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1.0 SCOPE

1.1 The scope includes work/service for the complete design, engineering, manufacture, testing at works, Third Party Inspection, supply of all electrical equipment, dispatch, storage, handling, erection, testing at site and commissioning of complete electrical system required for 'ROM Coal/Petcoke/Limestone Handling from Railway Siding to Storage Yard'.

Although every item of supply and/ or installation might not have been described, the LSTK Contractor shall supply anything and everything to complete the project.

1.2 This specification shall be read in conjunction with all drawing and documents attached and other relevant reference as specified therein.

1.3 The scope of work/ services of LSTK Contractor shall comprise complete electrics of the ROM Coal/Petcoke/Limestone Handling from Railway Siding to Storage Yard'. The scope of work/ services shall broadly comprise but not limited to the following:

1.2.1 Design & detailed engineering, Coordination, General Services etc.

- a. Basic as well as detailed engineering.
- b. Preparation of drawings/ document/ to suit Project implementation schedule. Preparation of drawings/ documents/ calculations/ formats/ test reports/ test certificates; Erection, Testing & Commission Manuals/ Operations & maintenance Manuals/ Reports/ QAP etc for approval/ Review/ reference/ record and/ or for any other requirement; submission to Owner/ Consultant in requisite sets, getting approval from Owner/ Consultant, making approved copies available to manufacturers, inspectors, erection & commissioning engineers, supervisors, owner/ Consultant etc as required in requisite sets well before those are actually required by them to fulfil their obligations.
- c. Design, manufacture, testing of equipment/ cables/ cable trays/ earthing and other erection materials etc at manufacturer's works, submission of documents with manufacturer's test reports/ type test reports to Owner/ Consultant prior to inspection call.
- d. Quality Assurance at each stage of manufacture including procurement of raw materials/ bought out items and arranging inspections by Owner/ Consultant/ Third Party.
- e. Obtaining dispatch clearance from Owner in writing.
- f. Packing, loading, forwarding, delivery at site/ store, loading/ unloading, storage as per manufacturer's recommendation; shifting from stores and handling in store as well as at site for erection.
- g. Arrangement of testing/ checking instruments/ kits/ sets/ apparatus with valid calibration certificates issued by duly accredited laboratories/ institutions, to carry out tests stipulated in specification and documents referred therein/ other applicable standards.
- h. Deputing electrical contractors, supervisors, electricians, cable jointers etc. on full time basis. for carrying out electrical work.
- i. Installations of equipment/ cables/ materials.
- j. Conducting pre-energisation tests to ensure that installation is fit to be energized.
- k. Erection shall not be considered complete unless pre-energisation tests are carried out, results are tabulated & submitted to owner/ consultant and results are found satisfactory.
- l. Conducting functional/ pre-commissioning checks/ Cold trial runs; no-load & load tests,
- m. Commissioning the installation.
- n. Conducting Performance Guarantee tests and taking corrective steps (inclusive of replacement of equipment/ materials if required) till results are satisfactory/ acceptable.
- o. Conducting Pre-Acceptance Tests/ checks and tabulating the results/ observations

	ROM COAL/PETCOKE/LIMESTONE HANDLING FROM RAILWAY SIDING TO STORAGE YARD TALCHER FERTILIZERS LIMITED DESIGN PHILOSOPHY – ELECTRICAL	PC183/E/4018/SecVI-3.3	0	
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- p. Liquidations of defects/ discrepancies/ observations noted during erection, pre-energisation tests, commissioning, trial runs, performance guarantee tests, Pre-acceptance tests/ checks etc.
- q. Submissions of all final/ 'As built' drawings/ documents after incorporation of changes made in soft as well as hard copies, duly certified by LSTK Contractor to the effect that those are 'Final' and/ or 'As built'
- r. Conducting Final Acceptance Tests/ Checks
- s. Co-ordinate with the Owner/ Consultant, other contractors/ agencies working at site as required for proper, smooth and timely execution of work/ implementation of the project
- t. Preparation of drawings/ documents, applications for getting the installation inspected and approved by Electrical Inspectorate of state and/ or Central Electricity Authority and all coordination for getting the installation approved for energisation & use. Carrying out all modifications/ alterations required by statutory authorities. All expenses on these activities shall be carried out and borne by LSTK Contractor. The obligation of owner shall be limited to

- Signing of application as Owner of installation and
- Payment of fee for inspection of installation.

Approved drawings and certificates shall be submitted to the Owner/Consultants well ahead of schedule so that the actual commissioning of equipment does not get delayed for want of inspection and approval by the Electrical Inspectorate and other statutory bodies. The actual inspection work by the Electrical Inspector shall be arranged by the LSTK Contractor and necessary coordination and liaison work in this regard shall be the responsibility of the LSTK Contractor.

1.2.2 Manufacture, testing at works, getting inspected by Owner and/ or their consultant/ Third Party, packing, transportation and delivery to site in well packed condition, insurance during transit and till commissioning & handing over, storing at site as per recommendation of manufacturer/ supplier/ direction of supervising engineer of Owner/ Consultant until required for erection, transportation to work place. Erection, testing & commissioning, handing over of complete electrical system of 'ROM Coal/Petcoke/Limestone Handling from Railway Siding to Storage Yard' (hereinafter referred as Plant in short) but not limited to :

- a. Bus Ducts
- b. Transformers viz.
 - 11/3.45 , 11/0.433 kV, 3.3./0.433 V Transformers, as required
 - Lighting Transformers
- c. Switchgears:
 - 11 kV ICOG Panel shall be provided (In case 11kV Switchgear is not applicable)
 - 11 kV Switchgears/ switchboards, as required
 - 3.3 kV Switchgears/ switchboards, as required.
 - 415 Volt Switchgears/ switchboards including PMCCs, MCCs, EPMCCs MLDBs, ASPBs (welding receptacle & other non-plant / non-critical loads are generally feed through ASPBs), LSDB, PDB, Junction boxes etc as required.
 - Local control Panels, Local Control stations, Switch Sockets.
 - Variable Frequency Drive Panels / Soft starters, as required
- d. 11kV, 3.3kV, 415V Motors and other special application/ voltage motors as required.
- e. All Cables viz

	ROM COAL/PETCOKE/LIMESTONE HANDLING FROM RAILWAY SIDING TO STORAGE YARD TALCHER FERTILIZERS LIMITED DESIGN PHILOSOPHY – ELECTRICAL	PC183/E/4018/SecVI-3.3	0	
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- Power Cables (11kV, 3.3kV and 1.1kV)
 - Control Cables,
 - Earthing Cable
 - Signal cables,
 - Optical fibre cables
 - Data Cables
 - Communication cables
 - Special application cables
- f. Erection/ installation & all sundry materials for installation, testing & commissioning of equipment/ panels/ fittings/ cables (including jointing & termination of cables) comprising (but not limited to) following:
- Foundations,
 - Brackets, support structures, erection materials & accessories, as required
 - Cable trays, racks, pipes, ducts, cable channels etc as required.
 - Testing checking kits/ instruments
- g. Illumination system - Normal, Emergency and Evacuation Lighting
- h. Area Lighting
- i. Aviation lighting, as required.
- j. Neutral Grounding, NER.
- k. Earthing of equipment & structures.
- l. Protection against lightning.
- m. 110V DC Batteries, Battery Charger and DC Distribution Boards.
- n. 115V AC UPS Panels with batteries & UPS & UPS Power Distribution Boards for Instrument.
- o. 240V AC UPS with batteries & UPS & UPS Power Distribution Boards for Electrical.
- p. Complete Electrics for Air Conditioning and Ventilation systems.
- q. Complete Electrics for Chemical Dosing System-
- r. Complete Electrics for fire fighting system,
- s. Complete Electrics for EOT Crane, Hoists,
- t. Fire Detection & Alarm System for Plant and Interface & Seamless Integration same with Centralised Fire Detection & Alarm System.
- u. Cable trench/Cable tray with supporting structure.
- v. Substation alongwith Transformer Rooms.
- w. The scope shall also include the erection, testing, commissioning of above equipments.
- The contractor shall clear the site after commissioning of the equipments / system and obtain the Site Clearance Certificate from Owner's Engineer-in-charge
- x. Any and all other Materials, Equipment and Services so as to make a totally integrated and functional system together with all accessories and associated equipment, ensuring safety, maintainability and reliability in compliance with all applicable codes, standards, guidelines, statutory regulations and safety requirements in force.

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- y. Any other equipment, not specified, but required for safe, proper, trouble free and efficient operation of the system
- z. LSTK Contractor shall consider any other requirement which is not covered in this NIT, but required for successful operation of the plant.
- aa. Spares & consumables for complete electrics as follows:
- Commissioning Spares (as per Clause No. 17.0 of Design Philosophy-Electrical) and Spares for 2 Years operation (Mandatory) for all equipments (as per Section VI-6.0: Spare Parts) shall be supplied by the Contractor as part of LSTK contract.
 - Contractor shall provide recommended spares (other than mandatory spare) for all the equipment (item-wise) with recommended quantity.
 - Spares and consumables required and first oil fills including short fall during erection, testing, cold trials, commissioning, performance evaluation tests, guarantee tests etc and till handing over of installation shall be supplied by the Contractor as part of LSTK contract.
- bb. Tools & Tackles.
- cc. Testing Equipments/ instruments
- dd. Arranging services of major equipment suppliers during installation and commissioning.
- ee. Training of Owner's Personnel for Operation & Maintenance of the Plant.
- ff. Any and all other items/ facilities/ services not specifically mentioned but essential/ required for completeness of the systems/ equipments/ facilities.
- 1.4 LSTK Contractor shall consider following additional feeders in their 415 V Switchboards / UPS Distribution Board of Coal Handling Substation for Owner's use
- a) 2 Nos. 125A Feeders in ASDB for Switch Sockets.
 - b) 1 Nos. 125 A Feeders (Indoor Bus) and 2 No125A Feeder (Outdoor Bus) in MLDB for Lighting Loads of Owner Use.
 - c) 1 Nos. 125 A Feeders (Indoor Bus) and 1 No. 125A Feeder (Outdoor Bus) in EMLDB for Lighting Loads of Owner Use.
- For 125 A feeder, approx. load of 30 kW shall be considered.
- LSTK Contractor to provide required provision in their transformers, Switchboards and other associated equipments for feeding these loads.
- 1.5 Normal power supply shall be tapped from 2 Nos. 11KV feeders at Owner's Offsite & Utilities Substation (OUSS) and further distribution shall be in LSTK Contractor's scope.
- Emergency power supply shall be tapped from 1 Nos. 11KV feeders (Emergency Bus) at Owner's Offsite & Utilities Substation (OUSS) and further distribution shall be in LSTK Contractor's scope.
- Bidder shall indicate the details of Normal Loads and Emergency Loads in the bid. Tentative Location of Offsite & Utilities Substation (OUSS) is marked in Plot plan.
- 1.6 This design philosophy contains specifications of the major equipments to indicate the basic requirement and serve as a guideline. However, it shall be the responsibility of the contractor to offer a complete quality electrical system of superior quality, even if the specifications of certain items are not given.. The items for which technical specifications are not indicated herein shall be of IS/IEC standard and specifications of these shall be subject to owner's approval in case of order.

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- 1.7 The bidder shall offer the best and proven most suitable type of energy efficient equipments manufactured by well known reputed manufacturers having proven performance track record of minimum 2 years , as per vendor list appended in this bid package. However for the sake of standardization of the electrical equipment and material used for the electrical installation, the LSTK Contractor shall supply all items of a particular type or make for whole plant of the same manufacturing company for ease of maintenance and less spares inventory.
- 1.8 1 No. 415 V Feeder (400 A) at Existing Substation near 132 KV Switchyard shall be made available by Owner for Construction Power. Tapping of Construction Power (on chargeable basis) from this feeder (including supply & erection of all required materials like structural supports for cable tray, cable trays, power cables, control cables, protection & metering, cable termination etc. as well as underground cabling work) and further distribution shall be in LSTK Contractor's scope.
- In construction Power, LSTK Contractor shall ensure that the minimum power factor of 0.9 shall be maintained at their end by providing suitable power factor improvement devices.
- LSTK contractor shall have to distribute construction power with adequately rated distribution and sub distribution boards/feeder pillars, power supply cables and other associated materials for feeding loads to carry out construction and fabrication activities at his own cost.
- Bidder shall indicate details of construction power in the bid with month-wise breakup for the entire duration of project.
- However during non availability of construction power, LSTK contractor shall have to arrange emergency power, if required, through DG set at their own cost.
- 1.9 Contractor shall provide adequate area lighting at site of construction, fabrication yards, storage yard and office etc. by means of suitable lighting fixture, lighting masts, flood lighting poles etc. which are to be supplied and maintained by the contractor as per safety aspect.
- 1.10 Relay Co-ordination & Relay Settings etc. of the entire electrical installation of ROM Coal/Petcoke/Limestone Handling from Railway Siding to Storage Yard 'shall be conducted by the LSTK Contractor using latest software preferably ETAP at appropriate stage of design-engineering.
- All the Electrical equipments shall be designed and selected according to the Short Circuit Study Report.
- In case equipment is ordered before studies are completed and revision of rating or design is required as a result of Electrical System Study then inclusion of such revisions shall be in LSTK Contractor's scope without any cost and time implication.
- 1.11 For control, monitoring, load management, data logging and printing of status of all important electrical equipment and feeders, a Programmable Logic Controller (PLC) / RTU based Electrical Control and Monitoring System (ECMS) shall be provided by Electrical Distribution System (EDS) LSTK Contractor. However, LSTK Contractor has to provide the required multifunctional dual channel transducers, Digital Multi-function Meters, latest version numerical/Communicable type protective relays with non-volatile memory, comprehensive unit providing protection, metering, control & communication with communication port & interlinked with Online Energy/Load Management System and required microprocessor based devices if any in panels , communicable door mounted Motor Protection Relays in all motor feeders of PMCC & MCC, proper communication facility in supplied UPS, Battery Chargers, VFD, Soft starter , MOV and other critical equipment for proper communication ECMS / DCS system. The interface of electrical equipments with ECMS / DCS shall be through IEC 61850 communication protocol for Numerical relays and IEC 61850/Modbus for Multifunction Digital Meters and MODBUS TCIP/IP for battery Charger, UPS, VFD, Motor Protection Relay (MPR) etc. , Ethernet communication module shall also be used. 100% redundancy shall be provided for communication i.e. the relay should have minimum 2 Nos. IEC-61850 communication port in addition to Front Port.

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All connection of numerical relays to Ethernet / Network Switch and looping of MFMs to Network / Ethernet Switches inside the switchboards and Network / Ethernet Switches, as required, for interfacing shall be in LSTK Contractor's scope.

All communication cables and all hardwiring cables (for DI, DO, AI, AO etc.) from Switchboards Ethernet/Network Switches to respective Substation ECMS cabinets / I/O Racks shall be in LSTK Contractor's scope. However, wiring / connection in I/O Racks shall be in EDS LSTK Contractor's scope.

LSTK Contractor shall provide separate room for local ECMS equipments (Data Concentrator Panels, OWS, EWS, PC console, chairs, furniture etc.) in substations of "Rom Coal/Petcoke/Limestone Handling from Railway Siding to Storage Yard". Provision of future expansion of Data Concentrator Panels etc. shall also be considered while designing separate room.

- 1.12 The scope shall also include obtaining all required statutory approvals from all statutory bodies. Contractor shall carry out all modifications/alterations required by statutory bodies.

All approvals for permanent installations shall be obtained in the name of Owner. Approval for equipment & installation for Construction Power shall be in LSTK Contractor's name.

- 1.13 In case of any discrepancies between Design Philosophy – Electrical and Technical Specification of equipment/item/work in respect of description of equipment/ item/work, the details indicated in the Design Philosophy – Electrical shall prevail.

- 1.14 Final location of equipments as well as route of cable trays shall be finalised during detailed engineering.

- 1.15 All electrical works associated with the followings but not limited to, shall be considered

- a) ROM Coal/Petcoke/Limestone Handling from Railway Siding to Storage Yard
- b) Air conditioning and Ventilation systems
- c) Fire fighting system,
- d) Fire protection system
- e) Cranes, Hoist, elevators
- f) Pollution control and monitoring equipment
- g) All auxiliary building & associated electrical building/rooms.

- 1.16 Following Interface & Integrations are envisage presently of LSTK Contractor ;

- Control & Protection for outgoing feeders of 11 kV Switchboard at Offsite & Utilities Substation (OUSS) to LSTK Contractor Switchboard (Inter tripping, Cable Protection etc.)
- Interface and Seamless Integration with Centralised Fire Detection & Alarm System.

However, any other interface and Seamless Integration requirement or any other unforeseen which may arise during detailed engineering/ execution stage, same shall also be in the LSTK Contractor's scope without any cost and time implication.

- 1.17 All the substations shall be provided with following equipment :

- CO₂ fire extinguishers (4.5 litre capacity) as per applicable NFPA.
- DCP fire extinguishers as per applicable NFPA
- Synthetic insulating mats on front and back side of all the switchboards. as per latest IS.
- Framed single line diagram in Aluminum frame with glass,
- Do's & Don't chart as per Indian Electricity Rules in Aluminium frame with glass.
- Shock treatment chart written in English and Local language duly framed and approved by engineer-in-charge.
- Caution boards / dangers boards written in ENGLISH & HINDI for all the voltage levels.
- CPR (CARDIO PULMONARY RESUSCITATION) Charts.
- High Voltage / Low Voltage danger signage (Skull & bones).
- Exit Route / Emergency Exit Route Signage.
- Cable Route Marker, wherever cable is in underground.

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- Sets of Sand buckets with stand (each with at least 3 sand buckets) for substations and transformer yards.
- HT and LT hand Gloves (3 Sets each for each substation).
- A Type FRP ladder 3 feet & 8 feet – 2 no each type for each substations.
- First Aid Box

Other requirement or any other unforeseen which may arises during detailed engineering shall also be in LSTK Contractor's scope

2.0 BASIS OF DESIGN

2.1 General

2.1.1 The electrical installation shall be designed to provide:

- Necessary amount of power
- Flexibility
- Service reliability
- Ease of expansion
- Ease of operation and maintenance & inter changeability of equipment
- Safety of personnel

The design of electrical installation shall ensure provision of a safe, efficient and reliable supply of electricity at all times including adverse system conditions. Safe conditions shall be ensured under all operating conditions including those associated with start up and shut down of plant as well as those arising out of failure of electrical equipment. The isolation of part of system of electrical equipment due to either maintenance or shut down shall not compromise safety aspects.

2.1.2 The design of electrical installation shall ensure provision of a safe and reliable supply of electricity at all times. Safe conditions shall be ensured under all operating conditions including those associated with start up and shut down of plant as well as those arising out of failure of electrical equipment, climatic conditions like lightning and earthquake etc. The isolation of part of system of electrical equipment due to either maintenance or shut down shall not compromise safety. All electrical equipments shall be of proven design and technology.

System shall be designed considering following aspects in general: -

- To facilitate inspection, cleaning and maintenance with the care to safety in operation and personnel protection.
- To minimize turnaround time.
- To provide safety, reliability and flexibility of service.
- Adequate provision for future extension and modification.
- Maximum inter-changeability of equipment.
- Desired level of operator interface to achieve coordinated efficient and fail-safe operation, data logging and maintenance of the equipment.
- To decide redundancy, stand by, spares and overload capacities to achieve desired reliability and flexibility requirement.
- To get cost effective and techno commercially proven technology. Economic considerations shall cover capital and running costs and an assessment of the reliability of the system.

2.1.3 All the electrical consumers within the battery limit shall be identified and listed to have complete details of rating, efficiency, power factor, operating duty cycle (continuous, intermittent, standby), category of supply required (emergency, normal, critical) etc.

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- 2.1.4 Required redundancy (based on specific process/operating needs) shall be built in substation which feeds power supply to process units/important facilities so that in case of tripping of one feeder, the unit may not be adversely affected and continuity in operation at full capacity is achieved.
- 2.1.5 While sizing the system necessary consideration shall be given to restrict the system voltage drop within permissible limits during starting of large rated motors. At the same time, the short circuit current shall be kept within limits keeping in view of the market availability of switchgears rating. For this purpose current limiting reactors/unit ratio transformers if required may be used.
- 2.1.6 LSTK contractor while performing design and engineering activities shall adhere to following guidelines.
- If any equipment is not covered in this design philosophy but required for successful operation of the project, LSTK contractor shall prepare additional specifications for equipment or bulk material taking reference of Indian/International Codes and good engineering practices prevalent in fertilizer industry and obtain owner's approval for the same.
 - The standard drawings attached with this package define the basic system design and distribution philosophy for the package. This is for guidance purpose only. LSTK contractor shall develop detailed drawings and submit for owner's approval.
 - LSTK contractor shall be responsible to verify the rating and consider providing equipment with adequate rating but not less than the specified rating. Compliance should be without any extra cost and time implications.
 - LSTK contractor shall consider any other requirement which is not covered in this bid package, but required for successful operation of the plants without any extra cost and time implications.
 - Contractor shall obtain approval from all statutory authorities such as Central Electricity Authority (CEA)/Electrical Inspectorate, Chief Controller of Explosives (CCoE), CPCB etc. for all electrical facilities including electrical switchboards & panels supplied and installed by LSTK contractor.
 - LSTK contractor shall Liaison and in all interface coordination with contractors of other units of project at construction, erection, testing & commissioning phase for any common facility and for smooth execution.
 - Equipment specification sheet/data sheets for all equipment shall be prepared by the LSTK Contractor based on relevant codes and Technical specifications/ Data sheets attached as reference. Data sheet shall contain all technical data and information which are essential for review and technical acceptability, detailed engineering, installation, testing, repair and maintenance, replacement etc.
 - LSTK Contractor shall clearly specify in their purchase specifications the requirement of conducting special tests/type tests, which are envisaged for various electrical equipment which shall have no impact on cost and time.
 - Bidder shall must visit the site and collect all relevant information required for designing of complete system before quoting. Bidder shall make themselves familiar with the work actually involved and actual site conditions. Failure to do so shall not absolve the Bidder of their responsibilities based on adverse site conditions.
 - All the electrical equipments shall be of proven design and technology.
 - Normal & Emergency Load details (rating of all motor, Lighting, Switch socket etc.) load shall be submitted.
 - Load Summary shall be prepared by LSTK contractor to determine ratings of electrical equipments (transformer, switchgears, cables etc.), to evenly distribute plant loads among the various substations and switchgear, and to evaluate the need for power factor correction. All calculation shall be necessarily reviewed/approved by Owner/Consultant.

Motors, heaters etc. shall be designed as per Section 4.0 : Design Basis of NIT.

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The maximum normal running load and the peak load shall be calculated as follows:

Maximum Normal Running Load = (100% of sum of all continuous load) + (40% of sum of all intermittent loads or largest intermittent load, whichever is higher).

Peak Load = (100% of sum of all continuous load) + (40% of sum of all intermittent loads or largest intermittent load, whichever is higher) + (20% of sum of all standby loads or largest standby load, whichever is higher).

Electrical System shall be designed for continuous Peak Load operation.

All the electrical equipments shall be designed / sized considering motor input power (i.e. BKW divided by motor efficiency).

Margin for future requirement shall be as per clause 2.1.6 m over the above.

Minimum P.F. shall be maintained as 0.95 at every voltage level.

All the electrical equipments like Transformers, Switchboards etc. shall be suitable for starting of the largest motor, while other loads are running, considering peak load condition.

- m) Electrical equipments to be designed by LSTK Contractor i.e. Transformers, Switchgears, MCCs, PCCs etc. shall have capacity for future requirements. The Margin shall be as follows:
- i) HV Transformer: 25% is added to the Continuous Peak Load.
LV Transformer: 30% is added to the Continuous Peak Load.
 - ii) Switchgear: Switchgear bus bar current rating as well as breaker shall be equivalent (nearer or higher standard rating size) to full load current of upstream Transformer.
 - iii) Switchboards and MCCs fed from other switchboards: shall be rated for 125% of peak load.
- n) The actual fault levels shall be arrived at on the basis of incoming power source, transformers, contribution of motors, etc.
- o) Prospective touch and step voltages shall not be adverse to the stipulations of relevant publications of Bureau of Indian Standards / IEC/IEEE-80.
- p) Sizing calculations for all the electrical equipments shall be submitted for review/approval, in case of award of order. Owner/Consultant's Comments, if any on the same shall also be considered and modification in any equipment shall be done accordingly, without any time and price implication.
- q) Seismic zone as applicable shall be considered for design of all electrical equipment.

2.2 Load Grouping

Electrical consumers shall be classified as 'normal / non-essential, emergency / essential or vital / critical loads as per the concepts defined below:

2.2.1 'Emergency' or 'essential' loads shall be identified on the criteria that, when failing in operation or when failing if called upon, will affect the continuity of operation, the quality or the quantity of product. For such loads, reliable source shall be ensured. Such feeders shall be grouped on a separate bus section in the respective Switchboards/ MCCs / PCCs.

2.2.2 Some of the loads which can be identified as emergency / essential load but not essentially limited to following:

- Electrical loads required for continuous operation of process plants utility in case of normal supply failure.
- Electrical loads required for safe shut down of facilities in case of normal supply failure.
- Emergency lighting & communication facilities.
- Fire Detection and Alarm System.
- AC & DC UPS / Battery charging equipment.

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- Control room AC equipment -Essential ventilation system for offices / Manned areas of other buildings.
 - Motorised valves as per process requirement
 - PA & Paging system (Load Details by Owner during detailed engineering).
 - AC Emergency Lub Oil Pump
 - Any other load (To be indicated by LSTK Contractor)
- 2.2.3 Critical' or 'vital' loads shall be identified on the criteria that, when failing in operation or when called upon, can cause an unsafe condition of the installation, jeopardize life or cause a major damage to the installation. For critical loads if any, UPS shall be provided to facilitate uninterrupted supply. The loads on UPS are AVR / PLC / DCS / Auxiliary supply for drives etc. Critical drives if any shall be provided with DC motors.
- 2.2.4 Some of the load which can be identified as critical / vital load but not essentially limited to following:
- Loads providing control and protection to plant equipment.
 - Loads serving critical equipment for safety of plant, equipment and / or personnel
- 2.2.5 Non-essential service is a service, which is neither 'essential' nor 'vital'. Hence the non-essential load does not require any special measure such as standby feeder or standby source to safeguard the continuity of service.
- 2.3 Statutory requirement Codes and Standards**
- 2.3.1 The design, installation, testing & commissioning shall conform to compliance of following statutory requirements :
- Indian Electricity Act
 - Indian Electricity Rules
 - The Indian Factories Act
 - The Indian Explosives Act.
 - Statutory requirement of Govt of Odisha and Govt. of India.
 - Guidelines, instructions, directions issued by Pollution control Boards of state as well as central government. Guidelines, instructions, directions issued by Chief Controller of Explosives (CCoE), CPCB, CMRI, DGMS, CEA etc.
 - Guidelines of Tariff Advisory Committee
 - Guidelines of Insurance Companies Association.
 - Any other applicable Rules/Acts/Regulations.

The design, installation, testing & commissioning shall be in accordance with established codes, good engineering practices and latest versions of following documents valid/ applicable on the date of acceptance of bid. The stipulations in these documents shall be considered as minimum requirements:

- Indian Standard Specification or equivalent IEC Standards
- Publications of IEEE
- API Standards
- National Electrical safety Code(NESC)
- Standards of Underwrites laboratory(UL)
- American Society for Testing Material (ASTM)
- American National Standards Institute (ANSI)
- Other International Standards

LSTK contractor shall be responsible for obtaining necessary statutory approvals from all the statutory bodies/authorities e.g. Electrical Inspectorate, PESO (earlier CCoE) as applicable before commissioning of electrical facilities. The CEA clearance for electrical equipment and components thereof shall be obtained by the contractor.

LSTK Contractor shall carry out all modifications / alterations required by all statutory bodies. However, necessary statutory fee shall be deposited by the Owner.

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2.4 Some of the bare minimum relevant Indian Standards are as listed below. However, system/equipment design shall be in line with latest edition of all applicable standards.

IS: 325, IEC:60034	Three phase induction motors
IS: 335	New insulating oil for transformers and switchgears
IS: 722	AC electricity meters
IS: 732	Code of practice for electrical wiring installations system voltages not exceeding 650V
IS: 737	Specification for wrought aluminum and aluminum alloys, sheet and strip (for engineering purpose)
IS: 996, IEC:60034	Single phase AC motors
IS:1248	Direct acting analogue electrical measuring instruments and their accessories:
IS: 1367 Part- 13	Hot dip galvanised coatings on threaded fasteners.
IS: 1646	Code of practice for fire safety of buildings and electrical installations
IS: 1913	General and safety requirements for Luminaries (Tubular fluorescent Lamp)
IS: 2071	Method of high voltage testing
IS: 2099	High voltage porcelain bushings
IEC:62305	Code of practice for the protection of buildings and allied structures against lightning
IS/IEC60079	Electrical apparatus for Explosive gas atmosphere
IS: 11171	Specification for dry type transformers.
IS: 2544	Porcelain post Insulators for system with normal voltage greater than 1000 volts
IS: 2633	Methods of testing uniformity of coating on zinc coated articles
IS: 2705	Current Transformers
IS: 3034	Code of practice for fire safety of industrial buildings, electrical generating distributing stations.
IS: 3043	Code of practice for earthing
IEC 61869-1	Instrument transformers — General requirements
IEC 61869-2	Additional requirements for current transformers
IEC 61869-3	Additional requirements for inductive voltage transformers
IS: 3177 IEC60034	Crane duty motors
IS: 3347	Dimensions for porcelain transformer bushings
IS: 3637	Gas operated relays
IS: 3639	Fittings and accessories for power transformers

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IS: 3646	Interior illumination: Part I & Part II
IS: 3716	Application guide for insulation co-ordination
IS/IEC:60529	Degree of protection provided by enclosure for rotating electrical machinery
IS: 4722	DC motors
IS: 4759	Hot dip zinc coating on structural steel and allied products
IS: 5082	Specification for wrought Aluminum alloys bars, rods, tubes and sections for electrical purposes
IS: 5561	Electric power connectors
IS: 5578	Guide for marking of insulated conductors (1st rev)
IS: 6362	Designation of methods of cooling of rotating electrical machines
IS: 6600	Guide for loading of oil immersed transformers
IS: 6665	Code of practice for Industrial lighting
IS: 7689	Guide for control of undesirable static electricity
IS: 8084	Interconnecting Bus bars for AC voltage above 1 KV upto and including 36 KV
IS: 9676	Reference ambient temperature for electrical equipment
IS: 10028	Code of practice for selection, installation and maintenance of transformers
IS: 10322-1	Specification for Luminaries,Part-1,General requirements
IS: 11353	Guide for uniform system of marking & identification of conductor & apparatus terminals
IS: 11448	Application Guide for AC electricity meters
IS: 12360	Voltage bands for electrical installations including preferred voltage and Frequency
IS: 12459	Code of practice for fire protection of cable runs
IS: 12615	Energy efficient motors
IS: 13234	Guide for short circuit calculations
IS: 13346	General requirements for electrical apparatus for explosive gas atmosphere.
IS: 13408	Code of practice for the selection, installation and maintenance of electrical apparatus for use in potentially explosive atmospheres
IEC: 60255	Electrical Relays
IS/IEC: 60947	Low voltage switchgear and control gear
IS: 60034-5	Degree of protection provided by Integral design of rotating electrical machines
IS: 60079-0	Explosive atmospheres, Equipment General Requirements
IS: 60079-1	Explosive gas atmospheres – Part-1 Equipment protection by Flame proof enclosures “d”.
IS: 60079-7	Equipment protection by increased safety “e”

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SP: 30	National Electrical Codes (NEC) - BIS Publication
IS/IEC 62271	HV Switchboard.
IEC 61439-1/2	LV switchboard (PCC/PMCC/MCC) for TOTAL TYPE TESTED (TTA). Type Test Certificates for short circuit withstand of 50kA for 1 sec. along with ACB mounted in the Switchboards shall apply.
IEC 61641	Switch Board with INTERNAL ARC CONTAINMENT test.
ANSI C-37:23	Metal enclosed bus
ANSI C-37:24	Effect of Solar radiation on metal enclosed bus.
IEC 60034	Rotating Electrical Machinery
IEC 61131	Programmable controllers
IEC 60871-1 /IS 13925	Shunt Capacitors for AC power Systems Specifications

Any other standard may be followed provided it is equivalent or more stringent than the standards specified above.

2.5 In case of any conflict/deviation amongst various documents the order of precedence shall be as follows:

- Statutory rules/regulation
- Design Philosophy
- Data sheets
- Technical specification/Installation Standards, etc.
- Applicable IS/IES standards

In case of contradiction / conflict among documents and statutory requirement, LSTK Contractor shall refer to Owner for clarification. However, most stringent specification shall be followed with Owner's approval. Owner decision shall be considered as final.

2.6 Site Conditions

The equipment shall be designed for the following site conditions:-

- Minimum ambient Temperature 1 C.deg
- Maximum ambient Temperature 46 C.deg
- Design Reference Temperature 50 C.deg
- Relative Humidity 100%
- Altitude above mean sea level Lower than 1000 Mtrs.
- Atmospheric pollution Dusty due to presence of Coal Dust & Urea Dust and corrosive due to presence vapours of Ammonia.

Equipment/ cables selected shall be derated for (a) higher ambient temperature, (b) restriction in temperature rise (c) variation in voltage, (d) variation in frequency (e) installation conditions viz. proximity to heat sources, bunching, layering, separation from others/ laying in conduits etc. with respect to the conditions for which it was designed & manufactured. Various de-rating factors considered shall be informed with supporting documents.

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Equipment to be installed in MCC rooms/ Electrical Rooms/ Control rooms shall be designed for + 50° C so that in case of failure of Air-conditioning/ ventilation facilities, the operation/ functioning of equipment is not be affected.

3.0 Deleted

4.0 SYSTEM DETAILS AND UTILIZATION VOLTAGES

4.1 The various voltage levels for in plant power distribution shall be as follows:

A. Normal Power	11KV ± 10%, 50Hz ± 5%, 3Ph, 3 W
B. Emergency Power	Voltage Variation ± 5%, 50Hz ± 3%, 3Ph, 3 W LSTK Contractor shall indicate Emergency Power required at OUSS.
C. Distribution Equipment	a) 11KV ± 10%, 50 Hz ± 5%, 3 Ph, 3 W with resistance earthed neutral b) 3.3KV ± 10%, 50 Hz ± 5%, 3 Ph, 3 W with resistance earthed neutral c) 415V±10%, 3 Ph, 4 W/240V ± 10%, 1 Ph, 2W, 50 Hz ± 5% solidly grounded neutral.
Combined variation in voltage & frequency	± 10%
Control Supply for: - 415V motors - Switch Gear Breaker controlled feeders: a. Closing, tripping & spring charging motor b. Auxiliary power	AC 240V ± 10%, 50 Hz ± 5%, 1Ph (For contactor controlled motors) Electrical UPS located in Substation. DC 110V ± 5% (For breaker controlled motors) – Battery Charger DC 110V ± 5%, 2 W - Battery Charger AC 240V ± 10%, 50 Hz ± 5%, 1Ph, 2W
- Instrumentation and Automation, DCS & Auxiliaries	AC 115 V ± 10%, 50 Hz ± 3% 1Ph, 2W – Instrumentation UPS located at Control Room
Voltage Ratings - Motors above 1000 KW - Motors above 150 KW up to 1000 KW. -Motors up to150 KW	11 KV, 3 Ph AC 3.3 KV, 3 Ph AC 415 V, 3 Ph AC
- Space heaters - Lighting - Panic Lights - Power Sockets/Receptacle	240V, 1 Ph AC 415V/240V AC 110V DC 415V, 3 Ph AC/240V, 1 Ph AC

4.2 The actual fault levels shall be arrived at on the basis of incoming power source, transformers, contribution of motors, etc. and shall be indicated in the Bid.

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All switch boards of the same voltage shall be rated for identical fault level. Minimum fault level to be considered for design and selection of equipment shall be as follows:

11 kV Switchgear – 40kA for 3 Seconds.

3.3 kV Switchgear – 26.24kA for 3 Seconds.

The fault level for 415V switchboards shall be 50kA for 1 sec.

Impedance of transformers shall be selected suitably (tap position at principal) without comprising voltage drop at receiving end.

11kV/0.433kV or 3.3kV/0.433kV Transformer rating shall not be more than 2000kVA.

Fault level of DC System shall be decided by the LSTK Contractor after substantiating the same by calculation.

4.3 System Earthing

The neutral of 11 KV and 3.3 KV systems shall be non-effectively earthed through resistance. The earth fault current of 11 KV and 3.3 KV shall be limited to full load current of the transformer or 400 A, whichever is less. Suitable protection system to be designed to have proper sensitive Earth fault protection.

The neutral of 415V supply system shall be solidly earthed.

The DC system shall have positive pole earthed through high impedance. Prospective touch voltage earthing shall comply with the requirements of relevant Indian/IEC standards.

5.0 POWER SUPPLY AND DISTRIBUTION.

5.1 Power supply from 11 KV switch board in Offsite & Utilities Substation of Plant

5.1.1 2 Nos. 11 kV Feeders and 1 No. 11 kV Feeders (Emergency Bus) shall be made available in 11 kV Switchboard at Offsite & Utilities Substation (OUSS). Tapping of power supply from 11 kV Switchboard at Offsite & Utilities Substation (including supply of all required material), structural supports for cable tray, cable trays, cables, cable termination etc. shall be in LSTK Contractor's scope. Further distribution to equipment at 11 KV, 3.3 KV, 415/240 V, 115 V (UPS) AC, 240 V (UPS) AC, 110 V DC etc. through proper type and size of cables, their supply, erection, testing and commissioning etc. shall be in LSTK Contractor's scope.

LSTK Contractor shall consider 11kV/3.45kV, 11kV/0.433kV or 3.3kV/0.433kV transformers for downstream distribution. The supply system shall be designed for maximum power requirement of the plant. Double radial system of power supply, each suitable for 125% of full load shall be followed for entire plants.

LSTK Contractor shall indicate details of power requirement and the Rating of 11kV Feeders at offsite & Utilities Substation in the Bid.

5.1.2 In the event of failure of normal power in the plants, the plants shall be brought to safe shut down condition through Emergency power. Emergency power shall cater to the load of emergency lighting, UPS system, battery charger, motorized valves, Fire alarm system, PA & Paging system in addition to the process loads for safe shutdown of the Plant and wherever required as per detail design.

Emergency power supply shall be tapped from 1 numbers of feeders (at Owner's Offsite & Utilities Substation – OUSS) and further distribution shall be in LSTK Contractor's scope. However, Bidder shall indicate the details of Emergency Loads in the bid.

5.1.3 The electrical system layout and interconnections (power as well as control) shall be such that the problem in electrical system of one plant should not affect the electrical system of other plant and vice versa.

5.1.4 The insulation system of cable, 11 kV & 3.3 kV equipments shall be based on unearthed system only.

5.1.5 Each incoming feeder shall be sized for 125% load of the switch board. The outgoing feeders shall be sized for the nominal load. Breaker rating of all the outgoing feeders of 11KV

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switchboards & 3.3 KV switchboards shall be same considering provision of interchangeability, except Incomer & Bus coupler Circuit Breakers.

- 5.1.6 Primary connections of transformers shall be provided with cables of suitable size and secondary connections shall be through cables/bus duct.
- 5.1.7 The entry of cables in all the switchboards shall be from bottom only.
- 5.1.8 All switchboards shall be provided with minimum two incoming feeders and one bus tie having auto/manual changeover facility.
- 5.1.9 It shall be possible to have momentary paralleling of power sources at 11 kV, 3.3 kV switchboards and 415V PMCC /PCC/MCC and trip the desired circuit breakers.
- 5.1.10 The normal operation of the 11 kV, 3.3 kV Switchgears, Power & Motor Control Centre (PMCC) and Motor Control Centre (MCC) shall be as under:
- i. Bus-coupler shall be provided between all the sources. Incomer and Bus-coupler breaker rating shall be same for all the switchboards. Each incoming feeder shall independently feed the loads on respective buses with full rated bus tie breaker open and the load on each bus balanced. In order to ensure maximum degree of reliability and continuity, automatic transfer from one incoming feeder to other shall be possible through auto/manual closing of bus tie breaker in case of sustained loss of power on any bus section.
 - ii. The bus tie breaker shall be provided with auto/manual selection. The bus tie breaker shall be independent in manual mode. In auto selection mode, the bus tie breaker is electrically interlocked with incoming circuit breakers, so that it cannot be closed unless one of the incoming breakers is open.
 - iii. When one of the incoming feeder trips, the bus tie breaker is closed automatically based on the philosophy described and the total load is transferred to other healthy incoming feeder which is capable of carrying the entire load. Sufficient switchgear capacity is to be provided. Time for changeover is suitably selected based on downstream system requirement of reacceleration of motors etc.
 - iv. Auto Change Over scheme shall be provided for incomer feeders and bus coupler feeder of 11kV switchboard, 3.3kV Switchboards and 415V Switchboards. Under normal operating conditions, incomer-1 and incomer-2 breakers shall be closed and bus coupler breaker shall remain open with 'Local-Remote-Off' switch in 'Remote' position. The bus coupler breaker shall close automatically under the following conditions being fulfilled:
 - Either of the incoming breaker trips due to under voltage (70% or below).
 - Voltage on the healthy bus is more than 80% for the set period.
 - Residual voltage on the bus with no power supply comes down to 30% or below.
Required nos. of bus PT, line PT and under voltage relays shall be provided to achieve the desired automatic changeover.
 - v. Auto transfer shall take place only on sustained loss of power on either of bus sections. Auto transfer shall be blocked in case of fault on either of bus sections or no power on both incomers.
 - vi. Paralleling of two incoming feeders is not foreseen. However, facility for momentary paralleling shall be provided for intentional changeover without interruption of supply with synchro check relay in Bus Coupler panel. There shall also be provision of selective tripping of one feeder out of three feeders with a Delay (two incoming feeders and one Bus Coupler).
- 5.1.11 EPMCC shall have 1 Normal and 1 Normal/Emergency incomer feeding critical load of plant whereas PMCC & MCC shall have 2 Nos. Normal Power Incomers feeding non-critical loads. DC Battery Charger, UPS System etc. shall be fed from EPMCC. PMCC shall fed breaker controlled feeders and various power feeders whereas MCC shall fed contactor controlled load and various power feeders. PMCC and MCC shall be separate.
- 5.1.12 Auxiliary Services Power Board (ASPB) having essential bus (to be fed from Emergency Bus of EPMCC) and nonessential bus (to be fed from Normal Bus of EPMCC) shall be provided in

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the plant for supplying power to welding switch sockets, lighting load, EOT crane and other auxiliary loads.

5.1.13 Separate MCCs be provided for Air-conditioning and Ventilation systems.

5.1.14 For the use of the Owner during plant shut down period, 1 No. indoor type feeder pillar, which shall be located in a separate room other than substation building and away from hazardous area. The feeder pillar shall be fed from the 415 V switchboards (PMCC) of the nearby substation. Each feeder pillar shall comprise of 1 No. 630 A 4 P MCCB incomer, 2 Nos. of 250 A TPN MCCB outgoing feeders, 2 Nos. 125 A TPN MCCB outgoing feeders and 4 Nos. 63 A TPN MCCB outgoing feeders. Other construction details shall be as per specification of sheet steel distribution board (PC183-TS-0808).

Location of feeder pillar shall be decided during detailed engineering.

5.2 Instrumentation Power

5.2.1 The power supply for instrument shall be 115V, 1Ph from UPS System.

5.2.2 Provision for 240V, 1 Ph power for lighting of instrument panels shall be provided from LSDB.

5.2.3 All instrument panels shall have two UPS incomer supply (one from different bus of UPS DBs) to avoid any type of power obstruction in case of failure of one supply.

5.2.4 Separate 240VAC UPS System shall be provided to feed MCC control supply, Control Room (to meet 250 lux in case of UPS Supply only)) & Substation lights (50% of total light) , ECMS Equipment, Fire Detection & Alarm System etc. This UPS System along with associated Battery (Ni-Cd) and UPS distribution Board shall be located at Substation.

5.3 Lighting Distribution

5.3.1 In substation a Main Lighting Distribution Board (MLDB) shall be in provided. MLDBs shall have two incomers through 415/433 V Lighting Transformers. One Incomer of MLDB shall be feed from PCC/PMCC and One Incomer shall be fed from EPMCC. In other areas the Lighting Distribution Boards shall receive power from MLDB. One third lighting load shall be connected to the emergency power (DG Source) to provide emergency light during failure of normal power. The MLDB Incomers shall have Metering facility with Digital communicable Multi-function Meters. MLDB shall have fault level of Min. 25 kA.

Both the lighting transformers feeding MLDB and their respective circuit breakers shall have same rating. Both the lighting transformers shall be designed for 125% load of MLDB.

35 % of total light of plant excluding Substation & Control Room shall be fed from Emergency Power (DG Power), in case of failure of Normal Power.

10% of total light or required Number of lights for safe evacuation, whichever is higher, shall be used as panic light (240V AC UPS), in case of complete shutdown.

The both normal and emergency section of Main Lighting Distribution Board shall have separate Sections of busbars for indoor and outdoor lighting. Indoor / Outdoor bus Sections shall be connected by means of suitably rated contactor operated through photo-cells / digital clock timer. There shall be provision to Switch ON & OFF Outdoor Type feeders from ECMS in Remote Mode.

5.3.2 Manual by-pass circuit for outdoor lighting shall be wired up to a switch located in Electrical control room / shift office, so that outdoor lighting can be switched ON or OFF manually to bypass the automatic switching.

5.3.3 All outdoor lighting fixtures and outside lighting of Sub-Stations, Offices, Control Rooms etc., shall receive power from outdoor lighting bus.

5.3.4 Demographical Electronic Timer and Contactor shall be provided for Outdoor Bus Section.

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5.3.5 Main Lighting Distribution Board shall feed Lighting Sub Distribution board having 63A 4 Pole MCB and ELCB as incomer, 16Amp DP RCBO as outgoing . The outgoing RCBO shall have rating of 300 /100 mA. Six, Nine or Twelve way Lighting Sub Distribution board shall be used having 30 % as spare outgoing RCBO feeder.

5.3.6 Welding outlets shall be fed from ASPB having 3 phase supply for welding connection. All welding outlets shall be provided with CBCT ELCB of 100 mA.

5.4 DC Power

5.4.1 110 V DC system shall be provided for control of circuit breaker feeders and panic lighting. It shall be obtained from Ni-Cd batteries.

5.4.2 The battery shall be provided with SCR controlled automatic rectifier-cum battery chargers and shall consist of Main Float cum Load charger, Standby Float cum Load charger and Boost Charger and 2 Nos. Battery Bank each of 60% capacity (of 5 hours backup at 100% capacity) with isolation facility for ease of operation & maintenance.

5.4.3 Each rectifier-cum- battery charger shall have independent power supply to be fed from the emergency source.

5.4.4 110V DCDB shall have 2 sources with auto changeover facility in case of failure of 1 source.

5.4.5 DC Battery Charger, AC UPS and HVAC for control room shall be fed from emergency switchboard.

5.4.6 Battery end cell voltage shall 1.1V. Aging factor shall considered 125% and Design margin of 20%.

5.4.7 For Temperature derating factor shall be based upon Minimum Ambient Temperature i.e. 5⁰C.

5.4.8 Battery Charger shall have at least 20% additional capacity for Owner Use. Battery Charger shall have 110 V DC system.

5.4.9 Separate Rectifier-Cum-Battery Charger with DC Distribution Board and Battery Bank shall be provided for each Substation.

5.4.10 The battery and charger combinations shall be such as to ensure continuity of D.C. supply at load terminals without even momentary interruption.

5.4.11 AC Ammeter and AC Voltmeter on Charger Input; DC Ammeter, DC Voltmeter for charger output/ battery voltage and on demand type Battery Charge / Discharge Ammeter shall be provided.

5.4.12 For all other specifications of Battery Charger , refer PC183-TS-0813.

5.4.13 For all other specifications of Battery Bank, refer PC183-TS-0814.

6.0 SUB-STATION

6.1 Elevated with trays in cable cellar : Yes

6.2 Complete Substation : Air-conditioned

6.3 Roof slab for

a Power transformer : Yes

b Distribution transformer : Yes

6.4 Batteries in substation and control Rooms : Separate room

6.5 Switchgear room : Air-conditioned

6.6 Battery charger in substation : Air conditioned

6.7 UPS Systems :Air conditioned

6.8 Nickel- Cadmium Battery :Separate room (Ventilated)

6.9 Variable speed drive panels : Air-conditioned

6.10 Thyristor controlled panels : Air-conditioned

6.11 Annunciation panel (HMI) : Operator Room in substation

6.12 The Sub-Stations shall be located near the load centres but away from hazardous areas as per IS/IEC. Actual size of substations shall be based on the final dimensions of substation

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equipments. Each Substation shall include Maintenance Room, Engineer Room, Shift Office (Staff Room), Gents toilet (both Indian and western WC), Ladies toilet (both Indian and western WC) etc.

- 6.13 The sub-station building shall have double storey construction. The ground floor shall have cable gallery and first floor shall have all switchboards, control panels etc. The switch room shall have Epoxy flooring. False ceiling shall be provided in Substation except Switchgear Room.
- 6.14 The cable gallery shall have a minimum clear height of 2.2 M (i.e. lowest cable tray should run at a height of 2.2 mtr. from finished floor level of cable cellar) and shall be closed on all 4 sides with two entries, preferably on opposite sides. It shall house all cable trays and their supports
- 6.15 Transformer floor shall be at least 300 mm above the finished floor level of cable cellar room.
- 6.16 In addition to the entry to substation for operating personnel, a separate entry of minimum 3.5M (H) X 3M(W) with rolling shutter shall be provided for all equipment entry. The rolling shutters should be manually operated with gear box. The Sub-station shall also have an emergency door opening outwards.
- 6.17 Sub-station wall adjacent to the transformer bays and walls separating transformers shall be 355 mm thick (inclusive of plastering) in case of brick construction or 240 mm thick in case of RCC construction upto roof slab. RCC roof slab shall be provided for Transformer, Series Reactor, capacitor etc.. The gate of Transformers shall be designed to prohibit bird entry.
- 6.18 Adequate number of Portable Fire Extinguishers of Dry Chemical Powder and Carbon dioxide shall be provided in suitable location in Substation, Transformer bays, Control room building etc. in addition to sand bucket as per CEA requirement. These extinguishers will be used during the early phase of fire to prevent its spread and costly damage.

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.

Dry chemical powder type extinguisher shall conform to IS: 2171.

Carbon Dioxide type extinguisher shall conform to IS: 2878.

- 6.19 Sub-station building shall be without any columns within the switchgear room to ensure optimum space utilization.
- 6.20 The layout of equipment shall be such that it shall have adequate space for installation, operation, maintenance and future expansion. The clearance of equipment from the walls/other equipment shall be adequate to ensure safety of working personnel. Generally the following norms shall be maintained for 11 KV/3.3 KV/415 V Switchboards:
 - a) The clear space of 2.0 M at rear side of 11kV/3.3 kV Switchboard.
 - b) A clear space of 1.5M behind the double front switchboards and 1M for single front.
 - c) A clear space of 3.0M between the two boards facing each other.
 - d) A clear space of 2.5M on either side at entrance/exit.
 - e) A clear space of 1.0M between two boards in same line after future panel space of switchboard.
 - f) A clear space of 1M in switch room from top of equipment.

- 6.21 The substation Switchgear Room, UPS & Battery Charger room, ECMS room, Control Room, Maintenance Room, Engineer Room, and Shift Office shall be fully air conditioned through centralised HVAC system (as per Design Philosophy – HVAC System) with proper ducting arrangement for uniform cooling, however all the equipment shall be suitable for operation

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- under specified ambient condition even on failure of air conditioning system. The substation shall have HVAC system so that the temperature inside the substation is maintained at 25 Deg.C in all conditions. Provision for remote alarm on failure of air conditioning system shall be provided. Indication of substation and control room temperature shall be provided. Heat load to be calculated on the basis of heat generation in the substation during peak summer period. Fire damper to be provided in the ventilation duct of the HVAC. There should be a separate room for installation of the HVAC Units located at ground floor.
- 6.22 Epoxy flooring of minimum thickness of 5 mm shall be done to reduce the heat load and improve the aesthetic look.
- 6.23 The battery room shall form a part of the sub-station. Battery room shall be provided with minimum n+1 flameproof exhaust fans and louvered opening in opposite wall/door. A sink with water tap shall be provided with water connection. Eye wash shower shall also be provided. Floor of the battery room and walls up to 2 M height shall have acid/alkali resistant protective epoxy coating. Light fittings, exhaust fan, on/off switches etc. in this room shall be chemical resistant type and flame proof type.
- 6.24 Location of battery charger shall be nearer to battery room.
- 6.25 To the extent possible Bus duct shall be in straight position. Bending of bus duct shall be avoided.
- 6.26 Staircases (with SS Handrail) and other rooms shall be paved with Kota stone.
- 6.27 Fixed type glass ventilators on all sides shall be provided near the ceiling height for natural lighting.
- 6.28 Arrangement shall be provided for lifting heavy equipment to be brought into the sub-station.
- 6.29 Sufficient nos. of entrances in line with National Building Code (min. 2) shall be provided for each floor.
- a. All doors of sub-station shall be air-tight fire proof steel doors except doors of control rooms/ PLC rooms which may have anodised aluminium frame with toughened glass panel. All doors shall open towards exit.
 - b. Windows shall have anodised aluminium frame and provided with toughened glass.
 - c. In case height is more than 10 meters, elevators (of capacity for 10 persons) shall be provided. Elevator shall be suitable for the area of installation.
 - d. 1000 mm wide insulating mat as per latest IS standard of appropriate voltage grade shall be provided in front as well as rear of each panel.
- 6.30 The Sub-stations shall also have an emergency door opening outwards as per latest edition of National Building Code.
- 6.31 .The sub-station shall house all the electrical power, control and monitoring equipment except those required for operation in the field. The equipment shall broadly include the following: -
- Transformers located in separate Bay/Room.
 - High Voltage Switch Boards
 - Power Control Centres
 - Power & Motor control centres
 - Emergency Power & Motor control centres
 - Motor Control Centres
 - Auxiliary Service Panel Boards
 - Lighting Transformer (Indoor / Outdoor as per requirement)
 - Main Light Distribution Board
 - Lighting Distribution Boards
 - Lighting Sub-Distribution Boards
 - Battery Sets

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- Rectifier-Cum-Battery Charger
 - Cell Booster
 - DC Distribution Boards
 - Rectifier-inverter Sets
 - 240 V AC UPS System alongwith UPS distribution board.
 - 115 V AC UPS System alongwith UPS distribution board
 - Neutral Earthling Resistors (Indoor / Outdoor as per requirement)
 - Input / Output Panels
 - VFD System
 - PA System (Space only)
 - HVAC System
 - Any other equipment required
- 6.32 All static devices such as Rectifier-Cum-Battery Chargers, Variable Speed Drive Panels, Soft Starter etc., shall be housed in a separate room. Heat load for panel to be taken by panel manufacturer.
- 6.33 Separation walls between transformers in all substations and safe inter transformer distances for switchyard transformers shall be provided.
- 6.34 Transformers shall be located in bays adjacent to the sub-station building. All bays shall have oil drained floor, surfaced with gravel or other suitable material.
- 6.35 In order to prevent leaking oil from reaching and polluting the water bearing stratum, transformers shall have the following provisions, depending on the oil capacity of the transformer.
- Oil Capacity up to 2,000 litres:
Transformers installed adjacent to sub-station shall be provided with oil soak pit with a layer of pebbles of about 40 mm granulation.
- Oil Capacity exceeding 2,000 litres:
Transformers installed adjacent to sub-station shall be provided with oil collection pit and sump pit as per Drg. No. PC183-PDS:E 114 for draining away of any oil, which may escape or leak from the tanks, to a waste oil tank.
- 6.36 A clear space of at least 1.5 meter shall be maintained all around the transformers after installation of HVWS System.
- High Velocity Water Spray (HVWS) System shall be provided for transformers fire protection having oil capacity more than 2000 Liters.
- 6.37 Separate common oil pits are required for Transformers.
- The volume of common oil pit will be 125% of the volume of oil of the transformer, which contains the largest volume of oil in transformers.
- The oil pit will be closed type of water-proof concrete construction.
- The oil pit will be connected to individual pit under each transformer and drain line of each transformer will be at least 150 mm dia pipe with a minimum slope of 1:96 as per TAC Regulation.
- Transformer fire/drainage of oil will be considered for only one transformer at a time.
- Level of pit will be so selected that there would not be accumulation of oil/water/oil-water mixture in the pit under each transformer.
- Pit shall be provided with 2 x 100% sump pump for common oil sump. 1 No. Portable sump pump shall also be provided.
- Oil Pit under Transformer and its Cooler Bank: Gravel filled open oil pit will be provided under each transformer and its cooler bank. The pit shall be such that it can take oil/water surge of 20% of the volume of the transformer oil. Level of pit shall be such that there will not be

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accumulation of oil/water in the pit. The gravel size will be 60 mm. Each pit will be connected to the drain line leading to new common oil pit.

- 6.38 In all substations/MCC rooms, space for future extension of switchboards shall be provided. Two panel extension space on each side (for each bus section) shall be provided for all HV Switchboards, PCCs. One panel extension space on each side (for each bus section) or two panel extension space on one side (in exceptional cases) shall be provided for all PMCCs, MCCs and ASPBs.

The HV switch boards and power control centres shall have sufficient number of spare feeders to the extent of 20% or 1 No., whichever is higher for each type & rating.

For other boards (PMCCs, MCCs, MLDBs, ASPBs, DCDBs etc.) sufficient number of spare feeders to the extent of 20% or 1 No., whichever is higher, for each type & rating shall be provided.

- 6.39 Fire protection for substations shall be provided to comply with requirements of relevant BIS (Bureau of Indian Standards) and other Indian/ International standards, as applicable. In case Indian standards are not available for any equipment, standards issued by IEC/ BS/ VDE/ IEEE/ NEMA/NFPA or equivalent agency shall be applicable.

In case of contradiction / conflict, most stringent specification shall be followed.

Substations shall be provided with smoke detectors and fire alarm system as specified elsewhere in the NIT and as per relevant Indian Standard.

- 6.40 Fire barriers shall be provided at cable/bus-duct entry/exit point. Cable shall have fire protection paint for 1 m length at building entry points and Panel entry points for above ground cables.

7.0 PROTECTION & METERING

- 7.1 Selection and co-ordination of protection and metering system shall be such as to ensure:
- Selective, sensitive and reliable protection of equipment against damage due to internal or external faults or atmospheric discharge.
 - Isolation of fault in the shortest possible time.
 - Simplicity of the scheme with maximum protection.
 - Uninterrupted operation of healthy system.
 - Personnel & plant safety.

- 7.2 Protective relays shall be of latest version, numerical / communicable type with non-volatile memory, comprehensive unit providing protection, metering, control and communicable with communication port for interlinking with online energy/Load Management System. 100% redundancy shall be provided for communication i.e. the Relay should have minimum 2 Nos. IEC-61850 communication port in addition to Front Port.. Numerical Relay shall have communication on IEC-61850 protocol in redundant mode and meters shall have communication on MODBUS protocol. Relay shall have 4 CT input for O/C and E/F protection. There should be option for derivation of E/F internally.

Relay shall meet the requirement for withstanding electromagnetic interference according to relevant parts of IEC 60255 / IEC 61850. Failure of single component within the equipment shall neither cause unwanted operation nor lead to a complete system breakdown.

The relay should support (tested for) IEC 61850 Edition 2 with parallel redundancy protocol as per IEC 62439-3 with two nos. of port and one additional port at front for local communication. Use of any type of converter is not acceptable.

- 7.3 The Numerical relay shall be provided with integral (no separate unit) arc flash protection system based on both current & light detection method. Relay should have provision of 3 nos. arc sensor, each for cable chamber, busbar chamber & circuit breaker chamber. Sensor shall

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cover any flash over occurring in the respective chambers. Facility should be there to adapt selective logic schemes for tripping only respective breaker or Incomer breaker.

- 7.4 The relay should support (tested for) IEC 61850 Edition 2 with parallel redundancy protocol as per IEC 62439-3 with two nos. of port and one additional port at front for local communication. Use of any type of converter is not acceptable.
- 7.5 Numerical relay shall indicate MWH, MVAR, MVA, V, A, Hz, PF. It shall have future provision for connecting with substation HMI. Separate multifunction meter with communication (for centralized energy monitoring) shall be used and shall not be part of protective device.
- 7.6 Relays shall support features like remote relay parameterization, disturbance recorder etc. It shall be possible to set/operate the relay from the front facia. Lock out relay shall be conventional type with hand reset facility.
- 7.7 LSTK Contractor shall supply licensed (lifetime) software along with required communication cables for Parameterization and viewing of disturbances, events, etc. through Laptop for all Make and models of Numerical relays. 1 No. Laptop complete (Minimum 8GB RAM, Minimum 1 TB hard Disk, latest processor) with all required software and accessories complete in all respect shall also be provided.
- 7.8 Special protection if required for any feeder such as differential, restricted earth fault, directional distance power relays etc. shall also be through numerical relay having serial port for monitoring.
- 7.9 In general all protection shall be through microprocessor based numerical relay. However high speed tripping relay shall be separate.
- 7.10 All Auto-changeover logic to be built in Numerical Relay. Numerical Relays shall have sufficient I/O to cater the same and there should be minimum 10 % spare I/O for future use. External I/O Card/ Module are not acceptable.
- 7.11 All Process Stop and other important Parameters shall be routed through Numerical relays for recording and Time-stamping. Hardware Annunciator is not required. Common Audio Visual Alarm for each Bus section of Switchboard shall be provided through Numerical relays.
- 7.12 Bare minimum protection for power distribution system shall be as indicated below. However, LSTK contractor shall provide any other necessary protection required for complete protection of system:.

Protection devices for power distribution system shall be as indicated below (Figure inside bracket refers to note below) (YES – Applicable)

Sl. No.	Relay Description	Relay No.	HV Tr. Fdr. Sec Wdg. Volt=> 3.3 KV	HV Tr. Fdr. Sec Wdg. Volt< 3.3 KV	HV /LV Motor Fdr., HV Breaker controlled contactor controlled	O/G Bkr. HV Plant Fdr.	O/G Bkr. MV PMCC	I/C HV	I/C MV PMCC
1.	IDMTL Over-Current Relay	51	YES	YES	-----	YES	YES	YES (2)	YES
2.	IDMTL Earth-Fault Relay	51N	YES (4)	YES	-----	YES	YES	YES (2)	YES
3.	Standby / Backup Earth Fault Relay (earthed neutral)	51G (10)	YES (22)	YES (22)	-----	-----	-----	-----	-----
4.	Motor Protection Relay with (50, 50N, 46, 49, 50L/R, 95)	99	-----	-----	YES	-----	YES	-----	-----
5.	Instantaneous Restricted Earth Fault Relay (Earthed side)	64R (10)	-----	-----	-----	-----	-----	YES (22)	YES
6.	Instantaneous Over	50	YES	YES	-----	-----	-----	-----	-----

	current Relay								
7.	Instantaneous Earth Fault Relay	50N	YES (5)	YES	-----	-----	-----	-----	-----
8.	Differential Protection Relay	87	YES (6)	-----	YES (7)	YES	-----	-----	-----
9.	High speed tripping relay	86 (18)	YES	YES	YES	YES	YES	YES	YES
10.	Trip Circuit Supervision Relay	95	YES	YES	YES	YES	YES	YES	YES
11.	Transformer Auxiliary Relay	63	YES	YES	-----	-----	-----	-----	-----
12.	Under Voltage Relay with timer	27 / 2	-----	-----	YES	-----	-----	YES (16)	YES (16)
13.	Check Synchronisation Relay	25	-----	-----	-----	-----	-----	YES (8)	YES (8)
14.									

Notes for Relay Protection Philosophy

1. All the numerical relays shall be of communicable type and connected to ECMS on IEC 61850 (Ethernet based) communication protocol with time stamping and time synchronization.
2. In case of HV switchboards with continuous parallel operation of incomers, following additional relays shall be provided:
 - a. One set of 87B (Bus differential) and 95 B (Bus wire supervision) for each bus section.
 - b. 32 (Directional IDMTL over current and earth fault) relays for the incomers.
3. In case of grid power supply EHV incomer following additional relays shall also be provided:
 - a. Relay 21 for distance protection, Relay 59 for overvoltage protection with timer, Relay 67 for directional over current protection, Relay 67N for directional earth fault protection, Relay 81 for under frequency / df/dt protection and Relay 98 as dead bus charging relay.
 - b. Minimum protection relays for EHV Transformer shall be 50, 50N, 51, 51G, 51N, 63TX, 64R, 86, 87T, 87F & 95.
4. Instantaneous earth fault (50N) shall be provided only for transformer with delta primary.
5. Directional IDMTL earth fault (67N) shall be provided for transformer with star primary.
6. For transformers rated 5 MVA and above.
7. For motors rated 1500 kW and above, excluding VFD fed motors.
8. Wherever auto-transfer feature is provided.
9. For switchgears where continuous or momentary paralleling of Incomers is envisaged, check synchronizing relay shall be provided.
10. 51G and 64R relays for input transformer of VFD system shall be decided by VFD Manufacturer.
11. The bus tie feeders in HV switchboards shall be provided with 51, 51N, 86 and 95 relays.
12. HV capacitor bank feeders shall be provided with 51, 51N, 59 (over voltage), 60 (Neutral displacement), 86 and 95 relays.
13. The following feeders shall be provided with timers for delayed tripping on bus under voltage while the under voltage relay shall be common for the bus
 - a. HV and MV capacitor feeders.
 - b. HV and MV breaker controlled motor feeders.
 - c. Contactor controlled motor feeders with DC control supply.

Numerical relays where ever provided for motor and capacitor feeders shall use in built under voltage relay and timer for delayed tripping on bus under voltage.
14. One no. DC supply supervision relay (80) shall be provided for each incoming DC supply to the switchboard.
15. In case of numerical relays, all relays shall be comprehensive units including all protection, metering and control.
16. Under voltage and over voltage function along with associated timer shall be part of the numerical relays.

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17. Auto changeover scheme control & logic between Incomers and bus coupler shall be built in the numerical relay.
18. Tripping relays (86) shall be separate relay. There shall be two nos. high speed tripping relay for motor feeder. One for electrical fault and one for process fault. Electrical fault relay shall be hand reset type and process fault relay shall be self reset.
19. Breaker control switch shall be hardwired type.
20. Stand by earth fault relay 51G shall be provided in the incomer of switchboard fed from transformers where transformer & switchboard both are located remotely from HV substation as well as in same HV substation.
21. For transformers located remotely away from HV Substation, a local power isolating device in the form of breaker panel without any protection relay shall be provided before transformer. A local emergency stop push button (Lockable) shall also be provided in transformer bay for tripping remote breaker.
22. Restricted earth fault relay 64R shall be provided for transformer rating ≥ 1 MVA in the incomer of switchboard fed from transformers having secondary winding star connected. This shall trip the HV side breaker.
23. Relay 87 and 64R shall be separate numerical relay. Hence shall not be part of main comprehensive numerical relay. CT for 87 and 64R can be clubbed, as two core of single CT.
24. Accuracy class of the current transformers shall be
 - Class PS for differential and special requirements.
 - Class 0.5 / 0.2 S for metering purpose.
 - Class 5P20 for protection purpose
 All the CTs shall have rated burden of minimum 15 VA and secondary rated current of 1 A.
25. Accuracy class of the potential / voltage transformers shall be
 - Class 5P for protection purpose.
 - Class 0.5 / 0.2 S for metering purpose.
 All the PTs shall have secondary voltage 110 V or 110 V / $\sqrt{3}$ and rated burden of minimum 50 VA per phase for both metering and protection core.
26. All the incoming, outgoing and tie breaker feeders of any HV & MV Switchboard shall be provided with numerical relays only with communication facility as protection devices. Releases shall not be acceptable in any case.
27. Numerical relays in all HV motor feeders shall be suitable for RTD / BTM inputs.
28. Each bus section shall be provided with separate under voltage relays.
29. Multifunction meter shall be provided to keep a record of power consumption and supervision of all concerned parameters like current, voltage, power, frequency, power factor etc. as specified. All the metering instruments shall be flush mounted.
30. Separate Communicable Digital Multifunctional meters shall be provided in all feeders with Numerical Relays for communication with ECMS system.
31. Motors shall also be provided with Unbalanced (-Ve) Sequence Protection Relay (46), as required.
32. Numerical under voltage relays (27) with time delay relay including VT fuse failure relay shall be provided for Bus VTs.
33. All Motor feeders of PMCC & MCC (irrespective of Rating) shall have door mounted communicable (Modbus / Profibus) type Motor Protection relay (MPR) with display.
34. No Meters, transducers or measuring equipments to be installed in the Protection CT circuit.
35. Cable Differential relays for both the end to be supplied by Downstream user contractor i.e. LSTK Contractor. Cable Differential relay will be of Fiber Optic Cable based communication only.
36. All required Alarms and Trips shall be incorporated in the Numerical relays. Sufficient LED shall be available in the Relays.
37. Trip Circuit Supervision relay shall be part of Numerical relay.

38. All Motors above 5.5KW and Outgoing Feeders above 100A shall Earth Fault protection with CBCT and Digital Earth Fault Relay with display.
39. Capacitor Feeder : 59, 27,50, 51, 50N, 51N, 60, CBFP etc.

7.13 Metering instruments shall be provided to keep record of power consumption and supervision of all concerned parameters like current, voltage, power (Active, Apparent and Reactive), frequency, power factor, Energy (Active & Reactive) etc. All the instruments shall be flush mounted. All meters shall be digital multifunctional meters with communication port for Load management at remote location. Additionally digital type ammeter, voltmeter and Hour Meter shall be provided separately for various feeders as indicated below :

The metering devices in HV and MV switchboards shall be as below:

- Type of metering: Analogue/As part of the Numerical relay
(Figure inside bracket refers to note below) (YES - Applicable)

Sl. No.	Feeder type	A	V	Hz	PF	MW	MWH	HM	MVAR	MVAH	MVA
1.	HV Incomer	YES	YES	YES	YES	YES	YES	----	YES	YES	YES (1)
2.	HV Bus Tie	YES	----	----	----	----	----	----	----	----	----
3.	HV Transformer	YES	----	----	----	YES	YES	----	----	----	----
4.	HV Bus PT	----	YES	----	----	----	----	----	----	----	----
5.	HV Plant Feeder	YES	----	----	----	----	YES	----	----	----	----
6.	HV Motor	YES	----	----	----	----	YES (kWh)	YES	----	----	----
7.	HV Capacitor	YES	YES	----	----	----	----	----	YES	----	----
8.	PMCC Incomer	YES	YES	----	YES	----	YES (kWh)	----	----	----	----
9.	PMCC Bus Tie	YES	----	----	----	----	----	----	----	----	----
10.	PMCC Bus PT	----	YES	----	----	----	----	----	----	----	----
11.	ACB Outgoing (Non Motor)	YES	----	----	----	----	YES (kWh)	----	----	----	----
12.	MV Motor (>55 KW)	YES	----	----	----	----	----	----	----	----	----
13.	MCC / ASB Incomer	YES	YES	----	----	----	----	----	----	----	----
14.	MCCB O/G (250A and above)	YES	----	----	----	----	YES (kWh)	----	----	----	----
15.	MLDB Incomer	YES	YES	----	----	----	YES (kWh)	----	----	----	----

Notes for Metering:-

1. MVA meter in external power supply incomers shall include maximum demand indication also.
2. Separate analogue type voltmeters with voltmeter selector switch and analogue type ammeters with ammeter selector switch shall be provided for incomers of all switchboards.
3. Ammeter (size 48mm x 48mm) shall be provided in space heater circuit of breaker fed HV & MV motors.
4. Apart from metering which shall be part of the numerical relays, Communicable digital multi-function meters of Accuracy Class 0.5 / 0.2(for Incomers only with suitable Metering CT shall be provided in all the breaker feeders of HV & MV Switchboard i.e. in incomers, bus coupler, outgoing plant feeders, transformer feeders, motor feeders, capacitor bank feeders, etc.
5. Multi function meters with serial communication over RS-485 or fiber optic cable, preferably with IEC protocol shall be provided in all the breaker feeders.
6. Power factor meter shall be provided for synchronous motors in addition to the metering provided for induction motors.

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7. For current feedback to DCS/PLC and VFD feeders motor current transducers shall be provided and mounted in switchgear panel.
8. CT operated Ammeter for all motor feeders above 5.5 KW, all MOV and LOPs shall be provided at both LCS and feeder end of switchboard.
9. All ammeters for LV motors shall be connected through CT. Only HV motors shall have 3 ammeters or ammeter selector switch or Voltmeter and Voltmeter Selector Switch.
10. Hour run meter shall be provided in all breaker controlled motor feeder.

8.0 CONTROL AND MONITORING

The following provision shall be made for control and monitoring of following electrical equipments.

8.1 Transformers

- TNC switch in primary & secondary side of switchgear.
- Emergency trip from secondary side for tripping primary side of transformer.
- VCB with all required protection to be considered in all the 11kV & 3.3kV switchboards. .
- Lockable 'OFF' push button in transformer room to trip sending end switchgear.
- Indication lamp for 'ON' 'OFF' 'Auto-trip', 'Non-trip' and 'Trip Circuit Healthy', 'Ready to Close', 'Ready for Service', 'Test', 'Service', 'Space Heater ON'.
- Ammeter and voltmeter on both primary and secondary side.
- Load break switch with Earthing Switch on transformer primary side (only where primary side circuit breaker is not located in the same sub-station).

8.2 Motors Controlled Through Circuit Breakers

- TNC switch, L/R Switch with Ammeter on LCS
- Current monitoring at DCS/PLC through Dual Channel Current Transducer with Display facility installed at switchgear end, where required from process point of view.
- Indication Lamps in switchgear for 'ON', 'OFF', 'Auto-trip' and 'Trip Circuit Healthy', 'Ready to Start', 'Ready for Service', 'Test', 'Service', 'Space Heater ON', 'Space Heater ON for Motors'
- Emergency trip in switchgear.
- Winding and bearing temperatures of motors shall be available at DCS in control room.
- Process interlock in CCR, where required.
- Control and Feedback for Motor Start & Stop command, Trip Indication, ON Indication, OFF Indication, Local / Remote Indication and Ready to Start Indication in remote (DCS/PLC etc.)
- Motors controlled through Circuit breakers should also be provided with ammeter, KVAh, KWH and running hour counter. Theses shall be incorporated in Numerical relay Or Multi-function Meter.

8.3 Medium Voltage Motors Controlled Through Contactors

- Start & Stop Push Button (Mushroom Stay Put Type) with Ammeter, Local/Remote switch on LCS.
- Current monitoring in DCS, where required from process point of view.
- Emergency Trip in PMCC/MCC.
- Process interlock in CCR, where required shall be wired through separate auxiliary relay.
- Indication lamp for 'ON', 'OFF', 'Ready to Start' and 'Fault' in switchgear.

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- Control and Feedback for Motor Start & Stop command, Trip Indication, ON Indication, OFF Indication, Local / Remote Indication and Ready to Start Indication in remote (DCS/PLC etc.)
- Motor space heater & Panel board space heater shall be provided with Ammeter & LED in Switchgear.
- All Motor feeders of PMCC & MCC (irrespective of Rating) shall have door mounted communicable (Modbus / Profibus) type Motor Protection relay (MPR) with Earth fault protection and display.

9.0 EQUIPMENT SPECIFICATION

9.1 General Features

- 9.1.1 The equipment shall be suitable for tropical climate conditions and corrosive and saline atmosphere.

All electrical equipment accessories and wiring shall have fungus protection involving special treatment of insulation and metal against fungus, insects and corrosion.

Fine mesh screen of corrosion resistant material, preferably SS shall be furnish on all ventilating openings to prevent entry of insects.

- 9.1.2 The equipment to be installed in indoor plant area shall be enclosed in dust, damp and vermin proof enclosure equivalent to IP 54 as per relevant Indian Standards/IEC.
- 9.1.3 The equipment excluding motors to be installed in outdoor plant area shall have IP 65 enclosure. Motors of Coal/Petcoke/Limestone Conveyor, Coal/Petcoke/Limestone Handling Section shall have IP 65 enclosure. Motors of other sections of Plant shall have IP 55 enclosure.
- 9.1.4 4 mm FRP (fire retardant and UV stabilized) canopies shall be provided for all outdoor equipments like motors, starters, LCS, SDBs, sw. sockets etc.
- 9.1.5 All the water plants being highly corrosive - Cable tray ,LCS, Junction boxes, Lighting JB and Lighting poles in plant area shall be strictly of FRP with SS fasteners only to avoid corrosion
- 9.1.6 The switch boards, to be installed inside the building shall have enclosure IP 4X for HV switchgear, for LV switchgear degree of protection shall be IP 52 up to 1600A rating and IP-4X above 1600A rating. Equipment requiring ventilation opening such as battery charger/UPS etc. located in air conditioning room may have IP 43 enclosure however, opening for the ventilation shall be covered with fine wire mesh.
- 9.1.7 Creepage distance shall be 31mm/kV (for highest system voltage) for all equipment.
- 9.1.8 All the electrical equipment shall be provided with rolled aluminium/stainless steel heavy duty double compression type cable glands and crimping lugs for the cable terminations
- 9.1.9 The outside surface of all equipment shall be painted after suitable pre-treatment by the application of two coats of anti-rust and corrosion resisting epoxy based paints.
- 9.1.10 All similar equipment (viz. HV Switchboard, LV Switchboard – PCC, PMCC, MCC, EPMCC, ASB, LDB, DCDB, Transformers, Numerical relays, UPS, Battery Chargers, Motors, etc.) supplied against a package should be of single Make only – for ease of O&M and spare management.

9.2 Power Transformers

- 9.2.1 The transformers shall be double wound, copper conductor, and Dyn11 type. Transformers shall rated for 11/3.45 kV, 11/0.433 kV , 3.3/0.433 kV, as required. Transformer with 3.45 KV Secondary winding shall be considered for the substation only, where 3.3 KV switchboard is to be installed for feeding 3.3 KV motors.
- 9.2.2 The rating of power transformers shall be selected on the basis of load and future load growth. For future load growth the following provision shall be made:-

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- 25% spare capacity in HV transformers above continuous peak load.
- 30% spare capacity in LV transformers above continuous peak load.

9.2.3 The rating of power transformers shall be selected keeping following into considerations:

- (a) Duty : Continuous
- (b) Outdoor type : ONAN/ONAF (ONAN rating shall have 25% spare capacity above continuous peak load. ONAF rating shall be minimum 15% above ONAN rating).
- (c) Indoor type : Dry Type
Epoxy cast resin/ resin encapsulated type
- (d) Maximum loading : 80% when one of the transformers is out of service
- (e) Peak efficiency at : 35% - 40% of load
- (f) Class of Insulation : B or better for oil filled
: F or better for dry type

9.2.4 Maximum temperature rise over ambient of 50 Degree Celsius shall be limited to:

- (a) Outdoor transformers:
 - Top oil (measured by thermometer) : 50⁰ C
 - Winding (measured by resistance) : 55⁰ C
- (b) Indoor transformers:
 - Winding (by resistance method) : 90⁰ C or lower as permissible for class of insulation offered

9.2.5 Special consideration shall be given in specifying the percentage impedance of the transformers to suit the switchgear short-circuit capacity available..

9.2.6 Transformers generally up to 10 MVA shall have ONAN cooling, while ratings above 10 MVA shall be ONAN/ONAF cooled. Bare minimum protection devices for transformer have been as indicated below; however LSTK contractor shall provide any other necessary protection relays required for complete protection of system.

Primary Side.

IDMTL Over Current, IDMTL Earth Fault, High Set Over Current, Instantaneous Earth Fault, Standby Earth Fault, Restricted Earth Fault , Differential (for sizes of 5 MVA and above), *Buchholz Alarm and Trip,*Winding Temperature Alarm,* Trip, *Oil Temperature Alarm, *Oil Level Alarm & Trip, *Trip for Winding Temperature and Oil Temperature. All protection except REF shall be provided on secondary side, if the primary side circuit breaker is located in other sub-station. REF protection shall trip the primary Inter-tripping of primary and secondary circuit breaker of transformer shall be provided for all faults through lockout relays.

CT for Restricted Earth Fault protection shall be provided inside the transformer.

9.2.7 High Velocity Water Spray (HVWS) System shall be provided for transformers fire protection having oil capacity more than 2000 Liters and rating upto 20MVA.

9.2.8 Following Push buttons shall be provided for transformers :

- Lockable 'OFF' push button in transformer room to trip the breakers on primary side.
- Push button shall be provided on breaker on secondary side for permission to close breaker on primary side
- Emergency trip PB on breaker on secondary side for tripping breaker on primary side of transformer.

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- 9.2.9 The instruments such as OTI/WTI, Buchholz relay and MOG shall have Magnetic Reed Switches. The mercury switch contacts are not acceptable.
- 9.2.10 For all transformers, conservators shall be provided with Magnetic Oil Gauge (MOG) having 1NO contact activated on Low oil level. For transformers above 2000KVA , Air cell shall be provided in the conservator.
- 9.2.11 Transformer rooms shall have roof slab.
- 9.2.12 Routine test on all transformers and heat run test on one transformer of each rating shall be performed in presence of Owner/Consultant.
- 9.2.13 All Routine, Heat Run Tests shall be performed in compliance with B.S.171, IEC publication No.60076, IS 2026 (parts I to V), CBIP and IS: 2026 (Part III) including SFRA Test before dispatch from Manufacturer's works and at erection site during commissioning or latest editions or any other authoritative standard. Certificates for Type Tests on similar type Transformers shall be submitted.
- 9.2.14 All Power transformers above 5 MVA shall have facility for Remote display (in ECMS) of Oil Temperature, Winding temperature, Conservator Oil Level and moisture ppm of Oil through 4-20 mA signal / Modbus communication.
- 9.2.15 Transformers shall be Energy Efficiency Level 2.
- 9.2.16 For all other specification refer PC183-TS-0803.

9.3 Neutral Earthing Resistor (NER)

- 9.3.1 The NER shall be provided to earth the neutral of 11 kV and 3.3 kV systems. Neutral of 415V supply system shall be solidly earthed.
- 9.3.2 Neutral earthing resistor shall be outdoor type made of AISI 304/406 punched stainless steel grid element. . The earth fault current of 11 kV & 3.3 kV shall be limited to full load current of transformer or 400 A, whichever is less.
- 9.3.3 All NER not requiring operation shall be provided with isolator.
- 9.3.4 For all other specification refer PC183-TS-0804.

9.4 Switchboards

9.4.1 General

- 9.4.1.1. There shall be three positions for Breaker/Contactor trolley: - Service, Test and Isolate. In service position, the power connections shall be made; but in test and isolate mode, the power connection of bus bars shall be automatically removed.

ACB feeder for PCC, PMCC & MCC shall be single front for ease of operation & maintenance. Non-ACB feeders for motors or power may be double front type.

Breaker duty cycle shall be O-0.3sec-CO-3min-CO.

Separate CT shall be provided for differential/REF protection.

LV circuit breaker shall be 4 Pole type except for outgoing motor feeders which shall be 3 Pole type.

- 9.4.1.2. Suitable shutter arrangement shall be provided to protect the person from accidental contact with live bus in trolley chamber.
- 9.4.1.3. The degree of protection shall be IP 4X for HV switchboards and IP 52 for LV Switchboard up to 1600A rating and IP-4X for LV switchboards above 1600A rating.
- 9.4.1.4. All HV, MV & LV Switchboards shall be LOTO compliance.
- 9.4.1.5. 11 kV & 3.3 kV Switchboard shall conforms to IS/IEC 62271-200, IAC-A FLR-50KA/40KA 1 Sec, PM, LSC 2B which means that the switchgear panels shall be four side internal arc tested, shall have metal partitions and shall confirm to loss of service continuity. LV

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- switchboard shall conform to IEC 60947. All 3 compartments (Busbars, Circuit breaker & Cable compartment) shall be tested for Internal arc for the said rating.
- 9.4.1.6. The observation window on the CB compartment door shall be made of special toughened/laminated glass substantiated in type test reports as proving it arc proof. Observation window shall be of same material and construction as the type tested design/construction as specified in IEC.
 - 9.4.1.7. Each cubicle shall be equipped with anti-condensation heater controlled by thermostat.
 - 9.4.1.8. Each HV compartment should have individual exhaust channel / pressure relief flaps to let out over-pressurized hot gases at the top of the switchboard in case of an internal fault. Suitable factory fitted arc duct arrangement shall be provided for venting out the arc out of the switchgear room.
 - 9.4.1.9. Front access doors with single action operator will be provided to the HV circuit breaker compartment and LT Relay compartment. Bolted type CB door locking arrangement shall not be accepted.
 - 9.4.1.10. The switchgear shall have integral making type earth switch with proper Mechanical & Electrical interlock. .
 - 9.4.1.11. An electro-mechanical device shall be provided to ensure the auxiliary circuits have been securely connected between the fixed and moving portions of the switchgear, before allowing closing operation of the circuit breaker. The voltage rating of the device shall be the same as the voltage used for the closing circuit.
 - 9.4.1.12. Tripping and closing coils shall be of continuous rated type to ensure longer life. All Feeders of 11 KV shall have Double Trip coil for safety.
 - 9.4.1.13. Circuit breakers shall be provided with a mechanically operated visual indicating device to display the circuit breaker switching state and a mechanical operation counter.
 - 9.4.1.14. The circuit breaker operations of closing and opening shall be possible with the circuit breaker compartment door closed.
 - 9.4.1.15. It shall be possible to trip the circuit breaker locally by mechanical means. Voltage Transformer (VT) shall be cast-resin with built-in primary fuses, VT's shall be draw out type.
 - 9.4.1.16. Voltage transformer shall be independent of circuit breaker carriage
 - 9.4.1.17. Electrical interlocks and castle key interlocks shall be provided between Bus-bar Earthing Switches and all Bus-bar Isolators of each Bus-bar Section in such a way that Bus-bar Earthing Switches cannot be closed when the Bus-bar Isolator of any circuit in the section is closed.
 - 9.4.1.18. Bus VT Miniature Circuit Breaker (MCB) ON auxiliary contacts and under voltage relay contacts shall be monitored in the interlocking scheme to confirm the dead bus condition.
 - 9.4.1.19. All CT & PT must be suitable for continuous operation of min. 20 % overload and for service under all rated and fault conditions.
 - 9.4.1.20. Current transformers shall be in accordance with IEC 61869-1 & 61869-2. The rated output shall match the requirements of the equipment connected. The secondary current rating shall be 1 A, .Unless otherwise specified, cores for measuring instruments shall have accuracy classes of not more than 0.5 % and saturation factors less than 5.
 - 9.4.1.21. Secondary terminals of current transformers shall be wired up to a terminal block with short-circuiting links, located at an accessible place. At this terminal block one side of each transformer shall be connected to earth.
 - 9.4.1.22. The CT rating plate and the terminals must be accessible after the Power cables have been installed.

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- 9.4.1.23. LV switchboard (EPMCC/PMCC/MCC) shall be TOTAL TYPE TESTED (TTA) design as per IEC 61439-1/2. Type Test Certificates for short circuit withstand of 50kA for 1 sec along with ACB mounted in the Switchboards shall be provided.
- 9.4.1.24. LV switchboard (EPMCC/PMCC/MCC) shall comply with Internal Arc Containment test as per IEC 61641.
- 9.4.1.25. The busbars and connection shall be made of electrolytic grade copper only. Aluminium busbars are not acceptable. All busbars of 11kV & 3.3kV switchgear including bus duct shall have Raychem sleeving suitable for Line to line voltage . Proper shroud to be provided in the joints.
- 9.4.1.26. Tripping and closing coils shall be of continuous rating type.
- 9.4.1.27. Clearance between gland plate to cable termination point in all switchboards shall be adequate but not less than 300mm to ensure proper cable termination.
- 9.4.1.28. FRP supports shall be used for bus bars with adequate clearances and creepage distance to prevent flash over due to effect of dust moisture.
- 9.4.1.29. Protective relays shall be mounted on the front of the switchgear panel.
- 9.4.1.30. All logic like, Auto/Manual changeover etc. shall be built-in the Numerical relay. Adequate number of I/Os shall be provided to meet the requirement. 10% spare I/Os shall also be provided. External I/O Card/ Module are not acceptable.
- 9.4.1.31. All relays used for protection shall be microprocessor based numerical type only with latest communication protocol IEC-61850 and shall have large graphical display. All relays shall have coating for protection against harsh environment conditions. All numerical relays shall be of one make only. Selected models of numerical relays shall have metering, control, status and protective functions. It shall be possible to save minimum 5 records of each event. Important functions and features, in addition to the fault measuring capabilities, shall include:
- Programmable scheme logic,
 - Remote communication interface for setting / interrogation from ECMS,
 - Local communication interface (HMI-keypad and / or serial PC communication),
 - Time-tagged events, fault and disturbance records,
 - Display of measured/processed quantities,
 - Self-monitoring (Hardware / Software),
 - Inter-protection communication,
 - Electronic transducer communication
- 9.4.1.32. All protection relays shall be provided with test plugs and all CT, VT wiring shall be wired through the test plugs in HV, MV & LV Switchboards.
- 9.4.1.33. The protection scheme(s) shall include all hardware and software to permit remote setting / interrogation / fault evaluation from the ECMS (engineering) workstation or from the computer monitoring system.
- 9.4.1.34. All protection relays shall be equipped with communication port using IEC protocols to work as an integrated part of the ECMS hierarchy. Should the relay schemes be offered from multiple Bidders / Contractors, all third party user interface software products shall be supplied to the ECMS platform to bring together all types of protective relaying into a unified control system hierarchy.

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- 9.4.1.35. Completely separate and isolated circuits shall be used for Switchgear control, tripping / protection, alarms, and auxiliary devices. These circuits shall have separate control power buses and feeders, suitably protected, for each power bus section.
- 9.4.1.36. Each control circuit shall be protected by a two-pole miniature circuit breaker with auxiliary N/C contact. The auxiliary contacts of all MCB's of the same circuit type, e.g. circuit breaker motor control, disconnect switch motor control, alarm, space heater, trip, etc., shall be wired in series to a group / common alarm terminal.
- 9.4.1.37. Each 11kV & 3.3kV outgoing/incoming and transformer feeder control panel shall include voltage detectors to indicate phases "ALIVE". The voltage detectors shall be connected to each phase on the cable side.
- 9.4.1.38. LSTK contractor shall supply minimum 1 No. laptops with licensed software for communication & configuration of all make & Type of Numerical Relays.
- 9.4.1.39. GPS system and associated hardware & software shall be provided for synchronisation of clocks of numerical relay and metering LA & ECMS
- 9.4.1.40. All meters shall be digital multifunctional meters with backlight LCD display and communication port. Additionally digital type ammeter, voltmeter and Hour Meter shall be provided separately for various feeders as indicated above.
- 9.4.1.41. All the motor / capacitor feeders controlled through vacuum circuit breakers shall be provided with surge arrestors. Lightning Arrestor (LA) shall be provided on each bus of 11KV Switchboard.
- 9.4.1.42. A continuous ground bus shall be provided at the bottom of the switchgear and in cable connection side for grounding the switchgear, breaker trolley as well as to ground the cable glands.
- 9.4.1.43. Control supply bus and space heater supply bus-bars (Copper) of adequate rating shall be provided throughout the length of switchboards with as many sections as sections in power bus-bars.
- 9.4.1.44. Control supply shall be tapped from control bus in each cubicle/ panel itself through DP MCB of suitable rating.
- 9.4.1.45. The minimum thickness of sheet steel used in HV and LV switchgear including charger, UPS, ASPB etc. shall be as under:-
- Base Channel minimum 3.0 mm
 - Load Bearing Members minimum 2.0 mm
 - Doors and covers minimum 1.6 mm
- 9.4.1.46. A bottom channel of not less than 100 mm shall be provided.
- 9.4.1.47. The maximum height of the switchboard and other control panels shall be limited to 2200 MM. Maximum height of component requiring operation shall be limited to 1800MM.
- 9.4.1.48. The switchboards shall have adequate short-circuit ratings and be suitably sized for the load and spare capacity foreseen. The short time rating of bus bar shall be 3 seconds for HV switch boards and 1 second for other boards.
- 9.4.1.49. The HV switch boards and power control centres shall normally have four spare circuit breaker panel (size shall be as per largest outgoing feeder breaker), two on each side of bus-section.
- 9.4.1.50. For other boards (PMCCs, MCCs, MLDBs, ASPBs, DCDBs etc.) sufficient number of spare feeders to the extent of min. 20% for each type & rating shall be provided.
- 9.4.1.51. The 415V switch boards shall have PVC insulated bus bar system suitable for rated voltage. At joints of these bus bars removable shrouds shall be provided.

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- 9.4.1.52. All HV & LV Switchgear, UPS, Battery Charger etc. shall have Ethernet/Network Switches and other communication equipments.
- 9.4.1.53. For interfacing with DCS system, separate marshalling panels (with 20% spare terminals) shall be provided on each bus section in all HV & MV switchboards in the same panel line-up. The marshalling panels shall be of full height same as that of switchboards. The horizontal bus bar chamber at the top shall be continuous through this marshalling panel also, for future extension of the MV switchboard. All critical control signals for DCS interface shall be hardwired between substations and DCS. Other non-critical data of Electrical system will be sent to DCS with redundant communication facility between DCS and ECMS.

Hardwired signals (with minimum requirement specified below) from various Motor feeders of a bus section for DCS interface shall be wired and terminated in the marshalling cabinet:

- DCS Start permissive
 - Process Start command (Auto)
 - Remote Start command (Manual)
 - Process Stop command
 - Process Trip command (for breaker controlled motor feeder)
 - Breaker/Contactor 'ON' indication
 - Breaker/Contactor 'OFF' indication
 - Ready to Start indication
 - Electrical Fault Trip indication
- 9.4.1.54. Following monitoring signals, as a minimum, shall be taken from substation to DCS interface, through redundant MODBUS SERIAL LINK communication from ECMS system.
- Load Data viz. KW, PF, A, etc.
 - L/R indication
 - Process Trip indication
 - Electrical Fault Trip indication
 - Trip Details
- 9.4.1.55. Auto changeover scheme shall be provided for incomers and bus couplers on all 11 KV switch boards, 3.3 KV switch boards and PMCCs/PCCs/ MCCs. Under normal operating conditions, incomer-1 and incomer-2 breakers would be closed and bus coupler breaker would remain open with 'auto-manual' switch in 'auto' position. The bus coupler switch would close automatically under the following condition being fulfilled:-
- i. Either of the incoming breaker trips due to under voltage (70% or below).
 - ii. Voltage on the healthy bus is more than 80% for the set period.
 - iii. Residual voltage on the bus with no power supply comes down to 30%.
 - iv. Auto change over shall be locked on loss of power on both the incomers.
- Auto changeover shall also be provided on switchboards catering to emergency loads.
- 9.4.1.56. Paralleling of two incoming feeders is not foreseen. However, facility for momentary paralleling shall be provided for intentional changeover without interruption of supply.
- 9.4.1.57. Every enclosure door that provides access to live parts operating at 240 V AC and above shall be mechanically interlocked with a circuit interrupting device on the supply side such that when the door is open, the equipment is de energised.
- 9.4.1.58. Separate redundant AC and DC control supply shall be provided for each Switchboard.
- 9.4.1.59. Control supply for motor feeders having MCCB in PMCC/MCC/ASPB etc. and VFD panels etc. shall be feed from 240V UPS (Electrical) and motor controlled with breaker shall have 110 V DC control supply irrespective of its being HV or LV.
- 9.4.1.60. For motors with auto-starting provision, trip of a running motor shall start standby motor automatically.

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- 9.4.1.61. All the HV/LV switchgear shall be fed through two separate transformers, each transformer having capability to take care of 100% load of the associated switchgear and shall have the facility of auto changeover in case of failure of one transformer as well as option of manual changeover for maintenance purpose.
- 9.4.1.62. Max. 3 runs of 400 sq.mm power HV cable shall be terminated in single panel. For more than 3 runs of cable complete dummy/adaptor panel shall be provided.
- 9.4.1.63. The CB ON and OFF lamp shall be provided at rear and front side of 11kV/3.3kV switchboards.
- 9.4.1.64. All breakers service ON/OFF contact multiplier contactors shall be mechanically latched type and independent of control supply. Loss of supply and restoring the supply shall not affect the status of the relay/ contactor.
- 9.4.1.65. All breakers shall be electrically operable and mechanical operation from the breaker shall be possible locally. Manual breakers are not acceptable.
- 9.4.1.66. Separate Ammeter shall be provided for panel and motor feeder Space heater circuit for each panel.
- 9.4.1.67. The terminal strips used shall be of stud and nut type and control wiring shall be done with ring tong lugs only.
- 9.4.1.68. Dual channel output with display type current transducer for all HV and LV switchboard feeder shall be provided requiring Ammeter at control panel.
- 9.4.1.69. All motor (HV/LV) power feeders shall have separate earth fault protection through CBCT and earth fault relay. LV motor (above 5.5. KW) and power feeder above 100A shall have CBCT and Digital earth leakage relay with display.
- 9.4.1.70. All external hardware shall be of stainless steel only.
- 9.4.1.71. The control compartment and power compartment shall be separate.
- 9.4.1.72. Following Set of accessories as detailed below shall be provided for each 11kV/3.3 kV Switchboard :
- a) Breaker handling trolley – 2 Nos.
- Following Set of accessories as listed below shall be provided for each 415 V Switchboard :
- a) Breaker lifting and handling trolley : Minimum 2 nos.
- b) Test cabinet with coupling cables for testing the breaker in draw out position : Minimum 1 No.
- c) Racking in/out handle for breakers : Minimum 4 nos.
- d) Racking in/out handle for draw out MCC modules : Minimum 2 for each MCC
- 9.4.1.73. Alarm relays with reverse flag shall be provided to annunciate failure of main incoming A.C. and D.C. power supplies and annunciation D.C. supply in each panel. Lamp indications shall be provided individually for main D.C. supply-1 fail, main D.C. supply-2 fail, and panel annunciation D.C. supply fail. A common A.C. electric bell shall be provided to give an audible alarm in case of failure of D.C. supply-1/D.C. supply-2/annunciation D.C. supply in any panel. A common push-button shall also be provided for cancellation of lamp indications and audible alarm.
- 9.4.1.74. Gland plate for single core cables shall be non-magnetic.
- 9.4.1.75. For all other specifications, refer PC183-TS-0805, PC183-TS-0806, PC183-TS- 0808 and PC183-TS-0809.
- 9.4.1.76. Separate panel shall be considered for incomer Line PT & Bus PT (11 kV & 3.3 kV Switchboards) and PT shall be draw out type. 4 pole MCB shall be provided on LV side of Bus & Line PT.

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- 9.4.1.77. Inspection window shall be provided for HV termination in the switchboard for carrying out thermography, provided internal arc test certificates for this design is available with the bidder.
- 9.4.1.78. All Incomers and bus couplers shall be provided with synchronising facility. Synchrocheck relay shall be provided in each bus PT & contacts shall be multiplied and wired in each outgoing feeders of each bus section.
- 9.4.1.79. All 11kV, 3.3. kV and 415 V Switchboards shall preferably be of same make for ease of operation & maintenance.
- 9.4.1.80. Supervision of installation, testing and commissioning including testing of Relays of all switchboards shall be done through OEM only.
- 9.4.1.81. All Cable Differential Relays shall be FO Cable type only. Supply & termination of the FO cable & associated HDPE duct, as required, for feeder differential protection shall be included LSTK Contractor's scope.
- 9.4.1.82. All Numerical Relays shall be of same Make and Model (series).
- 9.4.1.83. 11kV & 3.3kV Circuit Breaker shall have integrated earth Switch with proper Mechanical & Electrical Interlocks& Electrical Interlocks.
- 9.4.1.84. 11kV & 3.3kV Breaker rack in rack out facility should be operable only when breaker panel door is closed position.
- 9.4.1.85. LV Switchgear design shall be such that the feeder doors should not open in locked out tagged out condition.
- 9.4.2 11 KV Switchboard
- 9.4.2.1 The 11 KV switchboard shall be indoor, metal enclosed, draw out type, equipped with VCBs, stored energy mechanism working on 110 V DC and shall feed power to the various substations through transformers and other outgoing feeders.
- 9.4.2.2 Degree of protection shall be IP4X as per IS/IEC 60529,IEC 60298. Switchgear sizes and configuration shall be rationalized to minimum spare holding.
- 9.4.2.3 A study shall be conducted by LSTK Contractor to determine the rated short circuit capacity for the selection of equipment. However, Rated short circuit breaking capacity shall be as determined by the study or 40 KA for 3 sec, whichever is higher. HV Switchboard shall be suitable for Internal Arc (AFLR) withstand current of "rated short circuit current" for 1 sec.
- 9.4.2.4 Incoming, bus coupler and outgoing feeders shall be provided with ON, OFF, Trip, Trip Circuit Healthy indications. Process trip lamp/annunciator window to be provided wherever applicable.
- 9.4.2.5 Control supply shall be 110 V DC.
- 9.4.2.6 Extra anti-condensing space heater shall be provided in Bus –Bar and Cable chamber of 11KV Switchboard.
- 9.4.3 3.3 KV Switchboard.
- 9.4.3.1 The 3.3 KV switchboard shall be indoor, metal enclosed, draw out type, equipped with Vacuum Circuit Breakers (VCBs), stored energy mechanism working on 110 V DC. for all feeders.
- 9.4.3.2 The minimum degree of protection shall be IP4X as per IS/IEC 60529,IEC 60298. Switchgear sizes and configuration shall be rationalized to minimum spare holding.
- 9.4.3.3 A study shall be conducted by LSTK Contractor to determine the rated short circuit capacity for the selection of equipment. However, rated short circuit breaking capacity shall be as determined by the study or 26.24kA for 3 sec, whichever is higher. HV Switchboard shall be suitable for Internal Arc (AFLR) withstand current of "rated short circuit current" for 1 sec.

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9.4.3.4 Incoming, bus coupler and outgoing feeders shall be provided with ON, OFF, Trip, Trip Circuit Healthy, Spring Charged indications. Process trip lamp/annunciator window to be provided wherever applicable.

9.4.3.5 Control supply shall be 110 V DC.

9.4.3.6 Extra anti-condensing space heater shall be provided in Bus –Bar and Cable chamber of 3.3KV Switchboard.

9.4.4 Low Voltage Switchgears

9.4.4.1 415 V switchboards shall include the following:

- a) Power Control Centres (PCCs)
- b) Power-cum-Motor Control Centres (PMCCs)
- c) Emergency Power-cum-Motor Control Centres (EPMCCs)
- d) Motor Control Centres (MCCs)
- e) Main Lighting Distribution Boards (MLDBs)
- f) Auxiliary Services Power Boards (ASPBs)
- g) Emergency Power Distribution Boards

EPMCC shall be separate from PMCC.

9.4.4.2 Low voltage switchboards shall be metal clad, arranged with self supporting units and assembled together in a row..

9.4.4.3 Internal physical separation / segregation of 415 V Switchboards shall be 3 B for Non-ACB feeders and 4 B for ACB feeders.

9.4.4.4 The switchboards shall be suitable for extension at both the ends.

9.4.4.5 Bus bars shall be of uniform cross section and supported on non-hydroscopic FRP insulators with adequate clearances and creepage distance to prevent flash over due to effect of dust/moisture.

9.4.4.6 The horizontal busbars as well as vertical droppers of LV switchboards shall have heat shrinkable insulated sleeves.

9.4.4.7 Sufficient bus supports shall be given to give adequate mechanical strength during short circuits.

9.4.4.8 A continuous ground bus shall be provided at the bottom in the PCC/PMCC/MCC for grounding the PCC/PMCC/MCC.

9.4.4.9 Rated short circuit breaking capacity shall be 50 KA for 1 sec.

9.4.4.10 The PCC, PMCC, EPMCC MCC, Main lighting distribution board and auxiliary services power board shall be provided with withdraw able air circuit breakers for incoming feeders and bus ties.

9.4.4.11 All feeders of 415 V switchboards shall be provided with MCCB except feeder rated more than 400A, for which ACB shall be provided. All outgoing feeders shall be draw-out type in all the switchboards.

9.4.4.12 All ACBs shall be electrically operated- EDO type only. Manual breakers are not acceptable. Each electrically operated breaker shall be provided with antipumping (94), Breaker fail (52BF) and trip free feature, trip annunciation (30) and lockout (86) relays. Lockout relay shall be hand reset type.

9.4.4.13 All ACBs shall be without any internal releases. The required protections shall be wired by means of external numerical relays.

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- 9.4.4.14 Motor feeders below 75 KW rating shall be contactor controlled and 75 KW & above, these shall be ACB controlled with combined motor protection relay. All other feeders of 415 V switchboards shall be provided with MCCB except feeder rated more than 400A, for which ACB shall be provided. All outgoing feeders shall be draw-out type in all the switchboards.
- 9.4.4.15 Switchboards shall be provided with thermostatically controlled anti-condensation heaters.
- 9.4.4.16 All units in the MCC shall be completely accessible and removable from front. Both power and control connections shall be stab-in type.
- 9.4.4.17 Bus bar clearances shall conform to relevant Indian Standard/IEC for equipment voltages up to and including 500 V AC.
- 9.4.4.18 The switchboards shall be compartmentalized and individual feeder modules shall be draw-out type. Fixed type modules shall not be acceptable.
- 9.4.4.19 The draw out modules shall be standardized and it shall be possible to interchange any module with a module of same size. The components to control the equipment like MCCB, starter, auxiliary relay etc. shall be wired as a unit on the individual module. Safety shutter shall be provided to prevent direct access to live parts when the chassis is removed.
- 9.4.4.20 The entire draw out construction should be designed for safe operation during placement or removal of chassis. An earthing arrangement shall be provided which will make contact first before the power contacts are made and break last. Each module shall control one motor in general.
- 9.4.4.21 The door shall be interlocked so that it cannot be opened unless the isolating switch on that module is OFF. However, it shall be provided with a door defect mechanism for intentional opening when on line for testing and inspection purpose.
- 9.4.4.22 Control switches for breaker control shall be provided in each breaker cubicle. Circuit breaker shall be interlocked to prevent withdrawal of a closed breaker or insertion of a closed breaker. Each breaker shall be provided with anti pumping device.
- 9.4.4.23 Provisions shall be made to manually close/trip circuit breakers on loss of control voltage.
- 9.4.4.24 LV motor and power feeder above 100A shall have CBCT and Digital earth leakage relay.
- 9.4.4.25 All external hardware shall be of stainless steel only.
- 9.4.4.26 The control compartment and power compartment shall be separate.
- 9.4.4.27 The LV PMCC/MCC/PCC control supply shall be 240VAC, 50Hz UPS supply fed from UPS Distribution Board of Separate 240 V AC UPS System dedicated for MCC control supply; Control Room & Substation lights, ECMS Equipment, Fire Detection & Alarm System etc. Breaker control supply shall be 110V DC.
- 9.4.4.28 All low voltage switchboards shall be provided with 20% spare outgoing feeders or minimum 1 No. of each rating & type (fully wired) and with all the components.
- 9.4.4.29 The timers shall be electronic type only. Pneumatic or synchronous type timers are not acceptable.
- 9.4.4.30 Each outgoing motor feeder shall consist of a number of components mounted in a module duly wired. In general outgoing feeder rated below 75 KW shall consist of:
- MCCB.
 - Control supply On/Off switch and fuse
 - Power Contactor
 - Electronic Digital Motor Protection Relay with built-in Earth Fault, Overload, Stalling, Single phase protection, etc. Thermal Overload Relay is not acceptable.
 - C.T for metering
 - Overload reset button.

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- g) Process Trip / ON / OFF indicating lamp with separate indicator fuse.
- h) Auxiliary contactors for multiplication / control.
- i) Test position limit switch and test PB
- j) CT operated Ammeter for all motor feeders above 1.5 KW, all MOV and LOPs at both LCS and Feeder end.
- k) Selector switches as per requirement.

9.4.4.31 Following potential free contact shall be available for each Motor feeders for indication in ECMS in addition to process requirement:

- Motor ON
- Motor OFF
- Ready to Start
- Motor Process Trip
- Motor Elect Trip

9.4.4.32 Provision for indication of minimum following electrical parameters in 415V PCC / PMCC/ MCC shall be made:

- a) ON OFF, TRIP, TRIP CIRCUIT HEALTHY, TEST, SERVICE Position, indication in ACB feeders.
- b) The KWH meters on incomers shall have provisions for sealing for tariff purpose, as required.
- c) MCC shall conform to the following as a minimum :
 - Motor starters rated for utilisation category AC3 and protection equipment with a minimum of type 2 co-ordination.
 - The number of modules per tier shall not exceed 6.
 - MCC incomer sizes and configurations rationalised to minimise spares holdings.

9.4.5 Auxiliary Supply Power Board

The ASPB shall generally be single front, floor mounted draw out type having essential and non-essential bus. Non-essential bus shall be disconnected in case of failure of normal supply through a contactor. Substation station shall have ASPB. Additional 2 Nos.63A Feeders shall be provided for Owner's use.

9.4.6 Lighting Sub Distribution Boards

The Distribution Boards shall be single front, non-draw out wall mounted type.

9.4.7 UPS Distribution Boards

9.4.7.1 The UPS Distribution Boards shall be single front, floor mounted non-drawout type for supply of 115 V AC / 240 V AC UPS Distribution Boards shall have 20% spare outgoing feeders of each rating & Type (fully wired) and with all the components

9.4.8 Direct Current Distribution Boards

9.4.8.1 The Direct Current Distribution Boards (DCDBs) shall be single front, floor mounted non-drawout type for supply of 110 V DC control power to switchgears and panic lighting. Each Substation station shall have separate DCDB. DCDB shall have 20% spare outgoing feeders of each rating & Type (fully wired) and with all the components

9.5 Motors

9.5.1 The rating of LV and HV motors shall be selected from the sizes as recommended in relevant Indian Standard/IEC.

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9.5.2 All electric motors shall meet the standard IEC 60034-30-1.

9.5.3 The margin between the installed power and absorbed power shall be as recommended by the driven machine supplier but shall not be less than the following:-

Motor Rating	Margin above Driven M/C Absorbed Power
Less than 22 KW	25%
22 KW to 55 KW	15%
75 KW and above	10%

9.5.4 Voltage Ratings:

Voltage rating for the motors of different ratings shall be as below:

Upto 150 KW:	415 V, 3-phase, 50 Hz AC
Above 150 KW - 1000 KW:	3.3 KV, 3-phase, 50 Hz AC
Above 1000 KW:	11 KV, 3-phase, 50 Hz AC

All motors shall be designed for 3-Phase supply only.

9.5.5 The motors shall have maximum continuous rated duty S1 as per relevant Indian Standard/IEC. Rated duty for special duty motors wherever required e.g. cranes etc. Shall be considered as per driven equipment requirement.

9.5.6 All LV motors shall be TEFC type as per relevant Indian Standards/IEC while HV motors shall be TEFC/CACA type. All motors shall be Class-F insulated with temperature rise limited to that of Class-B.

9.5.7 Normally the motors shall be suitable for DOL starting. However, motors started through VFD shall be suitable to run at 30% to 100% of rated speed and compatible with the VFD.

9.5.8 All motors 30 KW and above shall have space heater provision.

9.5.9 All HV motors shall have winding, hot air and bearing RTDs. All the temperature signals shall be terminated to DCS as well as ECMS.

9.5.10 All LV motors shall be of efficiency class 'IE3' as per latest applicable version of IS: 12615. All HV Motors shall be of high efficient and high power factor type.

9.5.11 The starting current i.e. breakaway current of 415 V Motors shall not exceed the values indicated in IS: 12615. Also there shall be no further positive tolerance on the values of breakaway current.

9.5.12 The starting current of 11 KV & 3.3 KV motors shall not exceed 550% of FLC. No positive tolerance is acceptable over 550% FLC.

9.5.13 Type test certificate of similar motor for use in specified hazardous area (if applicable) shall be furnished.

9.5.14 The duty cycle of the motor shall meet the process and driven machine requirement.

9.5.15 In case of 11 KV & 3.3 KV motor, the terminal box shall be suitably designed for proper termination of XLPE insulated Aluminium cables through heat shrink termination kit.

9.5.16 The mechanical parameters such as duty, mounting type, shaft extension, direction of rotation, starting torque requirements etc. shall be adequate for the application. Sleeve or anti friction type bearings shall be used. Vertical motors shall have thrust bearings suitable for the load imposed by the driven machinery. Motors with sleeve bearings may require proximity probes to measure shaft vibration adjacent and relative to the bearings.

9.5.17 Motor rated above 30 KW shall have on line greasing provision and for motor rated above 45 KW, grease outlet feature shall be provided.

9.5.18 All HV motors shall have safety factor not less than 1.1.

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- 9.5.19 Motors rated 1000 kW and above shall have suitable measures to prevent flow of shaft currents and shall have 2 sets (i.e. 6 nos.) of PS class CTs for differential protection.
- 9.5.20 The motor shall be capable of withstanding the electro dynamic stress and heating imposed if it is started along with the driven equipment at voltage of 110% of the rated value.
- 9.5.21 During starting of large motor, the voltage may drop to 80% of the rated voltage for a period of 60 seconds. All electrical equipment, while running, shall successfully ride over such period without affecting system performance.
- 9.5.22 D.C. motor provided for emergency service shall be shunt/compound wound type. Motor shall be sized for operation with fixed resistance starter for maximum reliability.
- DC starters shall be complete with MCCB, contactors, resistors, relays, meters, push-buttons, lamps, etc. DC contactor shall be Class I – Category DC3. Switch Duty shall be DC22. The resistor enclosure shall be provided with ventilating louvers and wire mesh guard and shall have a degree of protection IP-23.
- 9.5.23 The motor may be subjected to sudden application of 150% rated voltage during bus transfer, due to the phase difference between the incoming voltage and motor residual voltage. The motor shall be designed to withstand any torsional and/or high current stresses, which may result, without experiencing any deterioration in the normal life and performance characteristics.
- 9.5.24 Shaft voltage shall be limited to 200 mV.
- 9.5.25 For all other specifications, refer PC183-TS-0810.

9.6 Rectifier-cum-Battery Charger

- 9.6.1 The Rectifier-Cum-Battery Charger shall be fully automatic using silicon controlled rectifier and shall consist of units as described below:-
- i) Main Float cum Load charger: To supply continuous load and keep the battery in healthy state.
 - ii) Standby Float cum Load charger: To supply continuous load & keep the battery in healthy state in case any abnormality in Main charger.
 - iii) Boost charger: To charge the battery set initially and recharge (after meeting emergency or sudden application of heavy loads.)
- 9.6.2 Substation shall be provided with redundant battery charger with 2x100% battery banks and connected to each Charger.
- 9.6.3 The battery and charger combinations shall be such as to ensure continuity of D.C. supply at load terminals without even momentary interruption.
- 9.6.4 AC Ammeter and AC Voltmeter on Charger Input; DC Ammeter, DC Voltmeter for charger output/ battery voltage and on demand type Battery Charge / Discharge Ammeter shall be provided.
- 9.6.5 Following analog signals through suitable transducer shall also be provided for hook-up in ECMS:
- Status of charging current (float & boost charging)
 - Battery current
 - Incoming voltage
- 9.6.6 Following potential free contacts shall also be provided for hook-up in ECMS
- DC under voltage
 - DC overvoltage
 - DC earth leakage
 - AC incoming power supply failure

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- AC input fuse blown-off
- Thyristor/ diode failure
- DC output fuse blown-off
- DC battery fuse blown-off
- Filter Capacitor fuse blown-off
- Load on Battery (using current direction sensing with time delay)
- Battery undervoltage/ Disconnected during discharge (using zero current sensing)
- Cubicle fan failure/ cubicle temperature high (for chargers with forced cooling).

9.6.7 For all other specifications, refer PC183-TS-0813.

9.7 **Battery Sets.**

9.7.1 These shall be Ni-Cd Battery Sets shall be rated to meet the total DC power requirement for 5 hour after complete power failure.

9.7.2 Spare capacity of 20% for future use shall be considered.

9.7.3 Battery shall be designed with minimum temperature as 5⁰C.

9.7.4 Load Test of all Battery to be done at site. Battery will be accepted based on load test only.

9.7.5 For all other specifications, refer PC183-TS-0814.

9.8 **Uninterruptible Power Supply System (UPS)**

9.8.1 115 V AC UPS System with UPS Distribution Board shall be provided to feed 115 V AC, 50 Hz, 1Phase power supply to the instrumentation system, DCS etc. This UPS System along with associated Battery and UPS distribution Board shall be located at Control Room.

Separate 240 V AC UPS System with UPS Distribution Board shall be provided to feed PMCC & MCC control supply, Control Room & Substation lights, ECMS Equipment, Fire Detection & Alarm System etc. This UPS System along with associated Battery and UPS distribution Board shall be located at Substation. Block Diagram of 115 V UPS System shall be followed but with 240 V in place of 115 V

Both 115 V AC UPS System and 240 V AC UPS System complete with Battery, UPS Distribution Board etc. shall be separate.

Both the UPS i.e. 240V AC and 115 V AC shall have with 20% margin for future use.

9.8.2 Both 115 V AC UPS with UPS Distribution Board and Battery Bank and 240 V AC UPS with UPS Distribution Board and Battery Bank shall be provided for each Substation.

9.8.3 The UPS System shall have IGBT type with touch screen LCD display and shall be backed up by nickel cadmium (Ni-Cd) battery rated for 2 hour at rated capacity of the UPS. Battery (100% Capacity) shall be separate for each Inverter.

9.8.4 UPS system construction shall be such that each charger, inverter module can be made fully isolated for maintenance. No common devices/wiring shall be installed. Further there shall be no common device between main & redundant units (e.g. master oscillators etc.) in order to ensure that the failure of the same does not cause shutdown of more than one unit.

9.8.5 UPS system shall have facility for built in Online battery bank monitoring & testing facility for displaying/calculating expected battery bank back-up time (during testing if battery bank does not have sufficient back up time, test shall be terminated & load shall be shifted to charger automatically).

9.8.6 UPS shall be suitable for 100% step load.

9.8.7 Battery Load cycle test shall be carried out by the vendor at site .

9.8.8 The UPS rating shall be such that in any case the load on the individual UPS shall not exceed 70% (after considering 20% future margin) of the rated capacity.

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9.8.9 UPS Configuration shall be as per attached Block Diagram. The over load capacity of UPS shall be 200% for 10 cycles, 150% for 60sec & 125% for 10min.

9.8.10 All four sections, i.e. Rectifier-I, Rectifier-II, Bypass – I and Bypass - II shall be fed through four separate feeders of emergency bus of PMCC.

9.8.11 UPS shall be PWM based using IGBT. Each charger and SCVS shall have isolating transformer at the input.

9.8.12 The salient features of the UPS shall be as under:

- a) High Efficiency
- b) Compatible to feed nonlinear, high crest factor loads
- c) Microprocessor based monitoring system for UPS status and fault indications
- d) High transient performance
- e) Low audible noise

9.8.13 Each UPS shall be provided with SNMP software so that all the parameters of UPS and alarms/faults can be viewed into the remote computer. These logs/trends of load can later be printed. Web based parameter and status monitoring shall be used. It shall be hooked to ECMS and DCS System.

9.8.14 The transfer time of UPS from inverter to bypass, in case of failure of both inverters, shall be so selected that during this transition period, instrumentation/DCS etc. which leads to tripping of plant shall not fail. Typically, it shall be as below :

- In synchronism : No break transfer i.e. within 6 milliseconds (Maximum)
 In asynchronous mode : Within 16 milliseconds (Maximum).

9.8.15 The technical parameters of UPS shall be as under:

Input

- a) Rated Voltage 415 V ± 10%
- b) Rated Frequency 50 Hz ± 5%

Output

- a) Rated Voltage 115 V AC / 240 V AC
- Voltage regulation:
 Static (0-100% load) ±1%
 Dynamic for 100% load change: ±5%

9.8.16 Following potential free contacts shall be made available on the UPS,

- Rectifier ON
- Inverter ON
- Battery CBB ON
- Load on Inverter
- Inverter fail
- Rectifier Fail
- Inverter O/P undervoltage
- Inverter Sync.
- Load on battery
- Bypass Fail
- Load on bypass
- Load transferred. etc

Note: A separate common potential free contact for all the faults/alarms (in UPS / SCVS) shall be made available

9.8.17 Operation Philosophy of UPS:

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- 2 sets of rectifiers and inverter shall be provided. Under normal conditions, when AC mains power is available, both the rectifiers shall operate in parallel and supply DC power for float/rapid charging the 2X50% batteries and simultaneously to inverters. In case of failure in one rectifier, the other rectifier shall feed the complete load and the batteries without any interruption.
- In case of Incoming supply failure or failure of both rectifiers the 2X50% batteries shall feed the inverters without any interruption. Each rectifier shall be designed for simultaneously feeding complete inverter load and float/rapid charging of the 2X50% batteries to its rapid capacity. Each rectifier shall be equipped with “On Line” automatic as well as manual charging facility.
- Normally both the inverters will be synchronised with each other and with stabilised bypass supply. Both inverters shall operate in parallel and share the load equally.
- The load sharing controls shall not be subject to common mode failure and any failure of the load sharing controls shall not result in the loss of the vital power.
- When a disturbance/fault occurs in any of the inverters, the faulty unit shall automatically get disconnected and the entire load shall be fed from the other inverter without interruption.
- In case both the inverters develop a fault, the complete load shall be transferred to stabilized bypass supply through the static switches and retransfer of the load from the stabilized bypass supply to the inverter shall be possible in auto as well as in manual mode without interruption.

9.8.18 All alarms & status of UPS shall be communicable through Modbus / Ethernet protocol to ECMS.

Following minimum shall be considered:

- Load on Inverter
- Load on Bypass
- Load on Battery
- Battery on float/ boost charging mode.
- Charger failure.
- Inverter failure
- AC mains failure
- DC under voltage
- DC Over voltage
- Automatic retransfer of load to inverter inhibited.
- Fan failure
- AC Voltage , current & frequency of each inverter
- AC incoming power supply Voltage & voltage.
- DC current at each rectifier output.

9.8.19 For all other specifications, refer PC183-TS-0802.

9.9 Variable Speed Drives (VSD/VFD)

9.9.1 Microprocessor based variable speed drive shall be communicable type and shall be able to communicate with ECMS/DCS. It shall be possible to set speed from process DCS for optimum performance through 4-20 mA signal. Speed/current/status feedback to DCS shall be provided. Drive will run at preset speed in the event of loss of signal from DCS.

9.9.2 System shall be highly reliable, efficient and shall provide high power factor, low harmonic distortion, low noise level etc.

9.9.3 System shall be provided with complete by pass circuit to ensure the power supply reliability in case of VSD/VFD failure. It shall be possible to start the motor in DOL mode through by-pass

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system in case there is any problem/fault in the VFD. The Electrical system and the process should be capable to operate the Motor in fixed speed (without VFD).

- 9.9.4 The system shall be suitable for load characteristics, continuous speed control. Drive shall be able to accelerate the load over the full speed range (0 – 100 %) with incoming line voltage regulation of 10%.
- 9.9.5 The system shall be designed for 150% over current withstand for 1 minute. The system shall be equipped with an automatic restart facility which will restart the system in case of voltage dip over 20% or power interruptions less than 4 seconds and recovery of voltage to 95% with a facility to block the automatic restart.
- 9.9.6 The system shall be suitably designed with due care for long length of cables, output filters, chokes, motor insulation, cable voltage grades etc.
- 9.9.7 The VSD panel shall be located in the clean air conditioned room in the substation. Required local control equipment shall have start, stop speed raise and lower push buttons, ammeter, speed indicator, ON/OFF/READY status selector switches as required and shall be installed near the motor.
- 9.9.8 The VFD shall be provided with Input and Output transformer.
- 9.9.9 "Auto Restart" facility for drive system within preset time, typically 0-15 seconds, in case of supply system dip or complete loss of power shall be provided.
- 9.9.10 Preferably screened type cables or cables as recommended by VSD/VFD vendors shall be used for VSD/VFD systems.
- 9.9.11 The VSD/VFD panels to be supplied shall be of proven model.
- 9.9.12 Training of VSD/VFD shall be provided to owner personnel.
- 9.9.13 For all other specifications, refer PC183-TS-0820A and PC183-TS-0820B.
- 9.10 Local Control Stations**
- 9.10.1 Local Control Stations shall be provided for all motors for testing and maintenance purpose when the selection is made is "LOCAL MODE" Operation. The essential features of the LCS shall be as given below:
- 9.10.2 LCS shall be pressure die cast aluminium housing (preferably), dust & vermin proof, weatherproof, suitable for wall or pedestal mounting with equipment mounted on a base plate inside and behind a front cover (bolted type).
- 9.10.3 Provision for pad locking in OFF position shall be provided.
- 9.10.4 Local control stations for breaker controlled HV and LV motors shall be provided with T-N-C switch, Ready to Start Indication, ON indication, Space Heater ON Indication, Trip Indication, Local-OFF-Remote Control switch and ammeter. Moreover, space heater ON indication lamp, trip indication lamp shall also be provided at the switchgear panel.
- 9.10.5 Local control stations for contactor controlled LV motors shall be provided with start/stop push buttons, ammeters and Space Heater ON Indication (for motor rated 30KW and above), ON indication, Local-Remote switch (as required) for the motors having rating 5.5 KW and above. If required from process point of view, ammeter shall be provided for motors below 5.5 KW also.
- 9.10.6 Each element for start and stop shall be provided with 1 NO + 1 NC contact. The push button construction shall be such to avoid mal-operation due to vibrations.
- 9.10.7 All local control stations shall have weather proof IP-65 enclosure. Canopies of suitable size shall be provided with all local control stations.
- 9.10.8 All components shall be completely wired up to terminal block and also provided with earthing terminals.

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- 9.10.9 Inscriptions on corrosion resistant metal strips giving drive description, mechanism number and functional requirement shall be provided.
- 9.10.10 Two numbers of LCS shall be provided for the motors, which are installed at elevated platforms. One shall be installed at ground level and the other near the motor.
- 9.10.11 The ammeter shall be flush mounting, moving iron spring controlled type, of accuracy class 1.5 as per IS: 1248, with square face of minimum size 72 mm × 72 mm having scale range 0-90 degree. The ammeter shall be provided with uniform scale up to CT primary current and compressed end scale up to the 8 times the C.T. primary current. Adjustable red pointer shall be provided to indicate the full load current of the motors. Zero adjusters shall be provided for operation from the front of the meter. All ammeters shall be operated through 1 Amp. CTs only.
- 9.10.12 Complete Push Button along with its actuator mounted on the cover with wiring done through flexible cables with proper protection.
- 9.10.13 Preferably Ring Type lug and suitable TB to be used for connection, to avoid loose connection.
- 9.10.14 All spare hole to be plugged with suitable metal plugs.
- 9.10.15 For all other specifications, refer PC183-TS-0817.
- 9.11 Switch Sockets**
- 9.11.1 Sufficient number of inter-locked type 125A/63A, 415V, 3 Ph and 16A, 240V, 1 Ph switch sockets shall be provided in various plant locations to facilitate the maintenance work. Supply to switch-sockets shall be taken from ASPB through suitably rated RCCB.
- 9.11.2 Both 3 Phase switch sockets and 1 Phase switch sockets shall be provided at Min. 20 M interval. Maximum 2 Nos. 63A switch sockets and 2 Nos. 16A switch sockets shall be connected in one circuit.
- 9.11.3 Sufficient no of Switch socket of (minimum 1 No.) 125A , 415V, TPN to be provided near Transformer bay for use of Transformer oil filtration machine.
- 9.11.4 For all Other Specifications, Refer PC183-TS-0811.
- 9.12 Conduits**
- 9.12.1 Conduits shall be of heavy gauge with minimum wall thickness of 1.4 mm (upto 25 mm dia) and 2 mm (above 25 mm dia) rigid steel, hot-dip galvanized, cut square, reamed, threaded and screwed tight at all joints.
- 9.12.2 Conduits entrances to pull boxes and switches shall have double lock nuts & insulating bushings. No running thread shall be used.
- 9.12.3 Flexible metallic conduit shall be used for connection to equipment which are subject to vibration and also for connection to level /limit/pressure switches. Conduit runs shall be supported at an interval of 750 mm for vertical run and 1000 mm for horizontal run.
- Conduits shall be sized so that conduit fill (ratio of total cable area to conduit area) shall not exceed the following :
- One Cable : 53%
- Two Cable : 31%
- Three Cables & Up : 40%
- 9.13 Bus-Duct**
- 9.13.1 The bus bars and connection shall be made of electrolytic grade copper only. Aluminium busbars are not acceptable. All busbars shall be insulated with Raychem sleeving.
- 9.13.2 It shall be suitably supported at regular intervals and both bus bars and supports shall be adequately sized and clamped to withstand rated short circuit current without permanent deformation.

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- 9.13.3 The bus bar insulators shall be non-hygroscopic, non-inflammable material. Earth bus shall run along the full length of bus duct without any break.
- 9.13.4 Outdoor bus-duct shall be weatherproof to IP-65 and shall be provided with canopy, silica gel breather. Construction of outdoor Bus duct shall be such that water gets drain off easily. Extra thickness shall be provided at the corners where water accumulation is likely to happen.
- 9.13.5 Bus duct shall be supplied with bus bar flexible links for connection at both the ends and expansion joints for every 3M of bus-duct and bus duct support materials.
- 9.13.6 Openings with cover at suitable locations shall be provided on bus duct for accessing the bus bars for maintenance.
- 9.13.7 Silica-gel breather shall be provided on both indoor and outdoor portions of the busduct. (shall not be required for pressurized busduct).
- 9.13.8 Proper sealing shall be done between Outdoor & Indoor section of the Bus Duct.
- 9.13.9 For all other specifications refer, PC183-TS-0807.

9.14 **Electrical Control & Monitoring System.**

- 9.14.1 Electrical Control & Monitoring System (ECMS) shall be provided for Supervision, control, monitoring, data acquisition, data logging & printing of status of all important electrical equipment & feeders and Load Shedding Scheme as per the recommendations of the system study report as per process requirement and in consultation with Owner/Consultant for entire fertilizer complex, by EDS LSTK Contractor.

Data concentrator Panel and other ECMS System Equipments including PC console, chairs, furniture etc. for 'ROM Coal/Petcoke/Limestone Handling from Railway Siding to Storage Yard' shall be in EDS LSTK Contractor's scope. However, LSTK contractor has to consider space for same in separate room in Substations, as per NIT.

LSTK Contractor shall provide multifunctional dual channel transducers in all the breaker feeders as well as contactor feeders of all important & critical Loads. Also, supply & installation of Network Switches and extend all signals up to Network Switches shall be in the scope of LSTK Contractor. Network Switch shall have 20 % spare ports.

Minimum Inputs and Outputs to be considered for ECMS for proper operation/control, effective monitoring and load management shall be inclusive of but not limited to the following:

a. Transformers:

Oil Temperature, Winding temperature, Conservator Oil Level and moisture ppm of Oil through 4-20 mA signal / Modbus communication and status of Buchholz Relay.

b. Incomer /Bus coupler/ Feeder (Power/Motor)

KW, KVA, KVAR, KWh, PF, VOLTAGE, CURRENT

ON, OFF, TEST, SERVICE, TRIP ON FAULT, TRIP CIRCUIT HEALTHY, CONTROL SUPPLY ON, RELAY WATCH DOG, FAULT DETAILS, DISTURBANCES RECORDER.

Remote ON & OFF Control from ECMS.

c. LT motor feeder of breaker controlled motors in EPMC/PMCC/MCC

KW, KVA, KVAR, KWh, PF, VOLTAGE, CURRENT

ON, OFF, TEST, SERVICE, TRIP ON FAULT, TRIP CIRCUIT HEALTHY, READY TO START, PROCESS TRIP, EMERGENCY STOP, LOCAL/REMOTE selection on LCS, CONTROL SUPPLY ON, RELAY WATCH DOG, FAULT DETAILS, DISTURBANCES RECORDER.

Remote ON & OFF Control from ECMS.

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d. LT motor feeder of Contractor controlled motors in EPMC/PMCC/MCC

ON, OFF, TRIP ON FAULT, READY TO START, PROCESS TRIP.

e. Breaker Controlled Power feeder in PCC/MCC/ASPB

KW, KVA, KVAR, KWh, PF, VOLTAGE, CURRENT

ON, OFF, TEST, SERVICE, TRIP ON FAULT, TRIP CIRCUIT HEALTHY, CONTROL SUPPLY ON, RELAY WATCH DOG, FAULT DETAILS, DISTURBANCES RECORDER.

Remote ON & OFF Control from ECMS.

f. UPS

Load on Inverter, Load on Bypass, Load on Battery, Battery on float/ boost charging mode , Charger failure , Inverter failure ,AC mains failure, DC under voltage, DC Over voltage ,Automatic retransfer of load to inverter inhibited ,

Fan failure ,AC Voltage , current & frequency of each inverter , AC incoming power supply Voltage & voltage , DC current at each rectifier output.

g. Battery & Battery Charger

Status of charging current (float & boost charging) , Battery current ,Incoming voltage, Load Voltage DC, Load current DC, DC under voltage
DC overvoltage , DC earth leakage ,AC incoming power supply failure ,AC input fuse blown-off ,Thyristor/ diode failure ,DC output fuse blown-off ,DC battery fuse blown-off ,Filter Capacitor fuse blown-off ,Load on Battery (using current direction sensing with time delay) ,Battery under voltage/ Disconnected during discharge (using zero current sensing) ,Cubicle fan failure/ cubicle temperature high (for chargers with forced cooling).

h. VFD

KW, KVA, KVAR, KWh, PF, VOLTAGE, CURRENT, SPEED , SPEED REFERANCE.

ON, OFF, TRIP ON FAULT, TRIP CIRCUIT HEALTHY, FAULT DETAILS

Remote ON & OFF Control from ECMS.

All Multi-function Meters of all HT, LT Switchboard , LDB, etc. to be connected with ECMS.

All connection/ wiring up to I/O Rack shall be in the scope of LSTK Contractor. Connection/wiring from Network Switch to Data Concentrator Panel & Centralized ECMS shall be in EDS LSTK Contractor's scope. However, cable tray, support for cable trays etc. for Cables from Network Switch to Data concentrator Panel & Centralized ECMS System (within battery limit of Rom Coal/Petcoke/Limestone Handling from Railway Siding to Storage Yard) shall be in LSTK Contractor's scope.

Redundant Power Supply from 240 V UPS Distribution Board to all ECMS equipment, OWSs, EWSs etc. (up to termination to I/O Racks, OWSs, EWSs etc.) shall be in LSTK Contractor's scope.

9.14.2 All relays and energy meters shall have communication facility for serial communication (Relays on IEC-61850 protocol and Meters on MODBUS protocol).

9.15 Junction Boxes

9.15.1 Junction boxes shall be provided on the machine body, where the terminal block of electrical equipment is not adequate for the termination of aluminium cables or to terminate an external multi-core control cable.

9.15.2 Separate junction boxes shall be provided for power and control cables. These shall be mounted at convenient and easily accessible locations.

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9.15.3 These shall be of cast aluminium enclosure having IP65 degree of protection and adequately sized, with terminal blocks, cable lugs and cable glands as required.

9.15.4 The cabling between these junction boxes and electrical equipment shall be in LSTK Contractor's scope of work.

10.0 CABLING

10.1 Cables

10.1.1 All HV & LV power and control cables for HV/LV switchgear shall be supplied and laid by the contractor. Terminations at switchgear end and at the equipment end shall be in contractor's scope. Supporting and laying of these cables shall also be in contractor's scope. Termination of HV/LV cables at HV/LV motor end and HV switch gear end including supply of heat shrink type termination kit for HV cables shall be in contractor's scope. Supply and execution of heat shrink type straight through jointing kits for HV cables shall be in the scope of the LSTK Contractor (if required).

10.1.2 Cables shall be sized considering the following factors.

- Maximum continuous load current
- Voltage drop
- System voltage
- Laying conditions
- De rating due to ambient air temperature, ground temperature, grouping and proximity of cables with each other, thermal resistivity of soil etc. shall be taken into account
- Short circuit withstand criteria.

10.1.3 All HV power cables shall be made of stranded aluminium conductor with XLPE insulation, PVC inner sheathed FRLS type, armoured, PVC outer sheathed FRLS type, conductor screen, insulation screen and construction as per IS: 7098 (Part 2). HV cables shall be of unearthed type.

Single core HV Power cable shall be of aluminium conductor. The construction of same shall be as per above.

10.1.4 All LV power cables shall be with stranded aluminium/copper conductor with XLPE insulation, PVC inner sheathed FRLS type, armoured, PVC outer sheathed FRLS type and construction as per IS: 7098 (Part 1). Power cables with conductor size upto and including 16 sq. mm shall be with copper conductor, conductor size 35 sq. mm and above shall be aluminium conductor.

Single core LV Power cable shall be of aluminium conductor. The construction of same shall be as per above

10.1.5 All control cables shall be with 2.5 sq. mm, stranded copper conductor with XLPE insulation, PVC inner sheathed FRLS type, armoured, PVC outer sheathed FRLS type and construction as per IS: 7098 (Part 1). Control cables shall be twisted pair or shielded wherever electromagnetic/electrostatic interference is anticipated.

10.1.6 All control cables shall have 20 % spare cores. All cores shall be identified with numerical core numbers printed on core in addition to colour coding.

10.1.7 All cables shall be armoured and shall have extruded inner and outer sheath.

10.1.8 Cables connected in parallel shall be of the same type, cross section and terminations.

10.1.9 All power and control cables shall be in continuous lengths (except for very long feeders) without any joints. The cables used for lighting and wires in conduits shall have appropriate junction boxes with adequately sized terminals. Cable joints in hazardous areas shall not be permitted.

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10.1.10 In case of length of any control cables comes out to be more than 400 Meters, FO cable with suitable accessories for proper connectivity shall be provided.

10.1.11 The maximum voltage drops in various sections of the electrical system shall be within limits stated in the following table:

Sl.No.	System Element	Maximum Permissible Voltage Drop
a)	High voltage cables for general distribution	1 %
b)	Bus duct / Cable between transformer secondary and Switchboards	0.5%
c)	Cable between PMCC and MCC or auxiliary switchboard i) MCC / Auxiliary Switchboard near PMCC ii) MCC / Auxiliary Switchboard situated remote from PMCC	0.5% Note-3b 2 to 2.5% Note-3a
d)	Cables between HV Switchboard and HV Motor (during running)	3%
e)	Cable between PMCC and motor (during running)	5%
f)	Cable between MCC (situated near PMCC) and motors	5%
g)	Cable between MCC (situated remote from PMCC) and motors	3%
h)	Cable between Auxiliary Switchboard / MLDB and Lighting Panel / Power Panel	1 to 1.5% (Note-2)
i)	Circuit between lighting panels and lighting points	4% (Note-2)
j)	DC Supply Circuit (electrical Controls)	5% and/or as per instrumentation requirement
k)	DCDB to Control Room	2% (Note-1)
l)	UPS outgoing circuit	5% (Note-1)

Note-1

Minimum voltage available across any instrument in the field / control room / satellite rack room shall be as per instrumentation design basis. Distribution system for instrumentation supplies shall be designed accordingly. In case of any conflict between electrical equipment specification sheet and instrumentation design basis report, the latter shall govern regarding instrumentation power supplies.

Note-2

In case of difficulty in achieving specified voltage drops in cables up to lighting panel, 5% drop from Auxiliary Switchboard / MLDB up to lighting points may be permitted.

Note-3

- a) Higher voltage drop may be permitted between PMCC and remote mounted MCC / ASB; if overall voltage drop up to motor (from PMCC) is limited within 5.5%.
- b) For large substations 1% drop may be permitted.

The maximum voltage drop at various buses during start-up of large motor and / or motor reacceleration conditions shall be within the limits stated below:-

Sl. No.	System Element	Operating Condition	Maximum Permissible Voltage Drop
a)	At the bus bars of the worst affected Switchboard	Start-up of the large HV motor with other loads on the bus or reacceleration of a group of HV motors (Simultaneous start-up or group reacceleration of HV motors is not envisaged)	10%
b)	At the bus bars of the worst affected MV Switchboard (PMCC / MCC)	Start-up of large MV motor with other loads on the bus, or reacceleration of a group of MV motors.	10%
c)	Cables between HV Switchboard and motor	Motor start-up or reacceleration	5% (Note-a)
d)	Cable between MV Switchboard (PMCC / MCC) and motor	Motor start-up or reacceleration	10% (Note-a)

Notes:

- Higher voltage drop in motor cables may be permitted, in case the conditions given in Note b), c) and d) are complied.
- The voltage available at the motor terminals during start-up must be sufficient to ensure positive starting or reacceleration of the motor (even with the motor fully loaded, if required), without causing any damage to the motor.
- For medium voltage motors, the voltage available at the motor terminals must not be less than 80% of the rated value during start-up or reacceleration.
- For high voltage motors, the voltage available at the motor terminals must not be less than 85% of the rated value during start-up or reacceleration.
- Soft Starter / VFD Starter shall be considered for starting large HV motors if essential / unavoidable as per system design requirement / equipment design limitation. For cases other than starting limitation, requirement of soft starter / VFD for any drive shall be confirmed by Process Department.
- Unless otherwise specified as in clause e), all HV motors and MV motors shall be suitable for Direct on Line (DOL) starting.

10.1.12 MINIMUM CABLE SIZES FOR 415V MOTORS

Direct on line (D.O.L) start motors (2/4 pole motors)

MOTOR RATING	CABLE DETAILS			
	NUMBER OF RUNS	NO. OF CORES PER RUN	CONDUCTOR MATERIAL	CONDUCTOR SIZE (MM ²)
Below 3.7 KW	1	3	Cu	2.5
3.7 KW	1	3	Cu	4
5.5 KW	1	3	Cu	10
7.5 KW	1	3	Cu	10

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9.3 KW	1	3	Cu	16
11 KW	1	3	Cu	16
15 KW	1	3	Cu	16
18.5KW	1	3	Al	35
22 KW	1	3	Al	35
30 KW	1	3	Al	50
37 KW	1	3	Al	70
45 KW	1	3	Al	95
55 KW	1	3	Al	120
75 KW	1	3	Al	185
90 KW	2	3	Al	95
110 KW	2	3	Al	120
125/132 KW	2	3	Al	150
160 KW	2	3	Al	185

- Cables sizes as indicated above are for 2/4 poles motors fed from MCCs located near PCCs and PMCCs.
- Cable sizes for motors not confirming to above table (e.g. for 2/4 poles motors rated up to 150kw & motors with high starting pf), extended distance, reduced voltage starting, low speed motors, VFD driven etc. shall be worked out on case to case basis.
- However cable sizing calculation shall be submitted for approval.

10.1.13 Design Criteria for Cables/Bus Duct & Short Circuit Withstand Time:

a) Design criteria for cables/bus duct

Sr. No.	Design Criteria	3.3 kV / 11 kV	415 V
1.	Loads beyond 1000A rating and located near the transformer	Bus Duct / 1-core cable	Bus Duct / 1-core cable
2.	Loads located up to 200 M	Cable	Cable
3.	Loads located 200 - 1000 M	1-core cable / 3-core cable	1-core cable / 3.5-core cable
4.	Loads located beyond 1 KM	Cable	Cable
5.	Recommended limiting size of multi-core cable (sq.mm) / Single Core (sqmm)	3 Core x 400 / 1 Core x 630	3.5 Core x 300 / 1 Core x 630
6.	Insulation voltage grade	3.3 kV / 11 kV Unearthed	1100 V Earthed
6.	Type of cable insulation	XLPE	Power: XLPE Control: XLPE
7.	Power, Control & Earthing Cables	Armoured	Armoured

For breaker control motor circuits the selection of size will be made ensuring that the cable shall withstand a short circuit fault directly for 0.2 sec.

Suitable derating factors based on the site ambient conditions, method of laying and the no. of cables laid together shall also be applied.

b) Short circuit withstand time (seconds) shall be as follows for Breaker controlled feeders.

Bus duct	1 Sec.
Feeders to motors and transformer	0.25 sec
Feeders from PCC/PMCC to MCC	0.6 sec
Main 11 KV primary distribution feeders	0.7 sec
11 KV cable from transformer to switch board	1 sec

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Incomer from other switchboard	0.6 sec
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- 10.1.14 The minimum size of power cables shall be 2.5 sq. mm (Cu).
- 10.1.15 The control cables shall be 2.5 sq. mm (Cu). However, wiring in the panel/switch boards may be by means of 1.5 sq. mm (Cu) cables except for CT wiring which shall be 2.5 sq. mm. All the control and power wiring shall be carried by using FRLS wires only.
- 10.1.16 Deration factor, group laying factor etc. as per Technical Catalogue of Cable Manufacturer (of whose cables shall be supplied) shall also be considered while sizing the cables.
- 10.1.17 For all other specifications, refer PC183-TS-0815.

10.2 Cable Laying

- 10.2.1 The cables shall generally be laid on overhead racks. Pipe racks where available, shall be used to support the cable racks.

HV power cable shall be laid on cable tray in single layer having 1D spacing between the cables. LV power and control cable shall be laid on cable tray in touching formation in single layer.

HV Power, LV Power and Control shall be on separate trays. Instrument and electrical cable trays shall be separate.

Cables shall be clamped properly on the cable rack in such a way that position and layout of a particular cable shall not change throughout the rack so that it can be easily traced during maintenance jobs.

Walkway to be considered for access to Electrical / Instrument cables on pipe rack.

From substations to various electrical consumers, cable shall be laid overhead. However, wherever overhead cable routing is not feasible LSTK Contractor can go for cable trench / slit (Refer PDS attached with the NIT) as per the site requirement.

Wherever, pipe rack is not available and space for overhead cable laying is possible then dedicated structure for cable shall be made for cable laying and shall be in scope of LSTK Contractor.

- 10.2.2 The cable racks shall be ladder type, pre-fabricated from suitable hot dip galvanised steel. Maximum cable tray size shall be 600mm wide. Maximum supporting span shall be 2 Mtrs. as per PDS Doc. No. PDS: E 530. Cable trays shall be designed considering 25% margin for future use.

All cable racks must be provided with GI flat strip of size 75mm X12 mm as running earth all along the tray.

- 10.2.3 All FO cable shall be laid through HDPE pipe with all accessories(Connecting arrangement).
- 10.2.4 All cables shall be terminated using suitable cable lugs.
- 10.2.5 All HV terminations and joints shall be of RAYCHEM make only.
- 10.2.6 Bimetallic lugs shall be provided, as required.
- 10.2.7 In Control Room (excluding false ceiling) and Substation, lighting cable shall be laid in concealed conduit.
- 10.2.8 For all other specification of cable racks, refer PC183-TS-0816 & PDS attached.

11.0 ILLUMINATION SYSTEM

11.1 General

- 11.1.1 LED type lighting shall be provided. The average illumination levels in the various sections of the plants shall be as indicated in Annexure-I. All the plants and area lighting shall be energy efficient.

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11.1.2 LED type lighting shall be provided for all areas. The minimum illumination levels in the various sections of the plants shall be as indicated in Annexure-I.

LED shall conform to the following types and standards:-

Product Type	Safety Standard	Performance Standard
Self ballasted LED lamps for general lighting services > 50 V	IEC 62560 Latest Edition	IEC 62612 / PAS Publicly available specification
Control gear for LED modules	IEC 61347-2-13 Latest Edition	IEC 62384 Latest Edition
LED modules for general lighting	IEC 62031 Latest Edition	IEC / PAS 62717 Latest Edition
LED luminaries	IEC 60598-1 Latest Edition	IEC / PAS 62722-2-1 Latest Edition Luminaries performance – Part 2-1: particular requirements for LED
LEDs and LED modules	IEC TS 62504 Terms and Definitions for LEDs and LED modules in general lighting.	

ce factor for indoor lighting shall be considered as 0.7 and for Outdoor lighting 0.6.

The colour rendering index shall not be less than 90%.

The LED lights shall work satisfactorily at the design temperature of 50 Degree Celsius.

The life assessment of LEDs shall include control gears/ driver as well.

11.1.3 The specified illumination level shall be maintained after considering maintenance factor 0.5 for Coal Dust Area , 0.6 for plant & outdoor areas (other than Coal Dust Area) & 0.7 for indoor areas and utilisation factor as per manufacturer catalogues for size of room & type of fixture.

11.1.4 Separate area wise panic lights, fed from 110 V DCDB, shall be provided at strategic locations for safe evacuation of operation personnel. These shall be switched 'ON' automatically on failure of power supply to main lighting board and shall switch 'OFF' automatically on resumption of mains or after 1 hour of power failure to avoid draining of the battery. Location of these lights shall be judiciously decided from safety considerations. The outdoor lighting shall be photocell/timer controlled.

11.1.5 Voltage drop at the fixture from the MLDB bus shall not exceed 3%.

11.1.6 Aviation lights shall be provided on tall structures and all isolated structures. . Aviation Lighting shall be in accordance with International Civil Aviation Organization (ICAO) Publication Annexure 14 and to Indian Standards, together with the approval of local aviation authority..

LED type Low Intensity Aviation Obstruction Light suitable for 240V, 50 Hz supply. It shall be covered under Indian patent act (Govt of India) No. 188995. Degree of protection shall be IP-65.

The illumination intensity of aviation lights and mounting height shall be considered based on vicinity of civilian air terminal within 1 KM radius. Aviation lights at each location shall be fed from two separate and distinct DBs (one fed from normal bus and another fed from emergency bus of MLDB). In case aviation lights are not switched ON for any reason, whatsoever, a signal shall be sent to control room which will sound buzzer and also result in flashing of red light. On acknowledgement, buzzer shall stop but flasher will continue unless aviation lights are turned ON.

The fixtures shall have body of corrosion resistant aluminium alloy casting and shall be suitable for outdoor use and mounting on 40 mm NB G.I. pipe. Necessary electrical threading shall be tapped in the fixture for mounting.

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- 11.1.7 Plant lighting circuits shall be single phase (Phase & Neutral) rated 240 V AC. Each circuit shall be rated to 16A but not loaded more than 8A. A minimum of 25% of MCBs of each board shall be left as spares. The load on one lighting sub-circuit of lighting sub-distribution board and junction box shall be limited to 1000W approx.
- 11.1.8 The lighting sub-distribution board for control of lighting shall be standardized as 18-way, 15-way, 12-way, 9-way and 6-way type.
- 11.1.9 In plant office rooms, wall mounting boards shall be installed to control the lighting. These boards shall include switches for lights, fans, 15A/5A plug sockets and fan regulators etc.
- 11.1.10 15A plug sockets shall be fed through separate circuit of lighting sub-distribution boards/junction box having ELCB of 30mA.
- 11.1.11 16A plug sockets shall be fed through separate circuit of lighting sub-distribution boards/junction box.
- 11.1.12 Illuminated exit sign shall be provided in substation / Control Room .
- 11.1.13 Power factor of complete fitting shall be 0.95 min. at 230 V.
- 11.1.14 Lights from LED's shall be soothing to eye and without any bright spots on the floor/objects illuminated by the luminaries.
- 11.1.15 The driver shall be mounted internally and be replaceable with the aid of commonly available hand tools.
- 11.1.16 The LED module or array shall be designed in such a way that the failure of one LED shall not affect additional LED's.
- 11.1.17 Life expectancy of LED Luminaries shall be minimum of 50000 hrs with greater than 70% of rated lumen output.
- 11.1.18 Min. efficiency of LED driver: The minimum efficiency of LED driver shall be 85% for driver power output rating $\leq 40W$ and 87% for driver power output rating $> 40W$.
- 11.1.19 Short circuit protection /Open load protection shall be required for LED fixtures.
- 11.1.20 Surge Protection for minimum 2kV for indoor and minimum 3kV for Outdoor LED systems shall be provided. However, if a site is prone to lightning and surges 10kV surge protection shall be required. In case of outdoor luminaries, the Surge Protection Device (SPD) should be series type with fail safe.
- 11.1.21 Color temperature of LED Luminaries: 5700K
- 11.1.22 Cover type for outdoor type fittings shall be Toughened glass or UV stabilized polycarbonate whereas, whereas, for indoor and non-weather proof items, UV stabilized Poly Carbonate can be used.
- 11.1.23 For more details, refer PDS attached.
- 11.1.24 For lighting fixtures and 16 Amp plug socket circuits, 3 core 2.5 sq. mm (Cu) cable shall be used.
- 11.1.25 Junction Boxes shall be provided with all type of Lighting Fixtures for looping. Connectors are not acceptable.
- 11.2 LED Tube Lighting Fixtures (inside Substations)
- a) High quality LED fluorescent tube twin batten type complete with 2 X 20W tube eco friendly, no UV radiation as per the specification tabulated below:

Sl. No.	Parameter	Technical Specification
1.	Degree of Protection	IP-20
2.	Lumen output per Lamp	≥ 2000
3.	CCT	6500K

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4.	Luminous efficacy	≥ 100 lm/watt
5.	CRI	>80
6.	Guaranteed Life	≥ 50000 burning hours
7.	PF	>0.95
8.	THD	<10%

11.3 Street Lighting And Security Lighting

11.3.1 63A TPN outlet from outdoor lighting bus of main lighting board shall be taken direct to the TPN junction box to be mounted on pole through cable and looped from pole to pole.

11.3.2 FRP poles of suitable mounting height shall be used for street light and plant lighting (platforms/ structures/ access ways/ walk ways/ pump house/ pump bay etc.), steel tubular poles of suitable mounting height shall be used

The poles shall be subjected to min. following tests:

- Thickness of galvanising
- Drop test as per IS: 2713.

Deflection test as per IS: 2713

11.3.3 Hot dip galvanized octagonal high mast lighting shall be used for yard and general area lighting. LED type fittings may be used.

11.3.4 LED Street Lighting Fixtures

- LED Street Light Fitting with cool white light in Pressure Die Cast Aluminium Housing with UV Stabilized Poly Carbonate Cover with in-built power unit of 3500 lumen suitable for 240V, 50 Hz, System shall be used.
- Lighting fixture shall have 50000 hrs. Life Time, CRI>75, IP-65.

12.0 EARTHING AND LIGHTNING PROTECTION

12.1 Earthing

12.1.1 Complete earthing installation shall be done as per IS: 3043, IEEE-80, IE Rules and IEC recommendations. The earthing system shall be designed to:

- Provide a permanent & continuous path from equipment and conductor enclosures to earth from circuits for flow of fault current.
- Provide sufficient current carrying capacity to conduct safely any current liable to be imposed on it.
- Provide sufficient low resistance to earth to limit the potential between metalwork and earth within safe limits.
- Provide equal distribution of potential and minimum potential difference for safety of personnel.
- Ensure sufficient current in case of fault to facilitate the operation of relays, over current devices, fuses etc. provided in the circuit.

12.1.2 Common underground earthing grid shall be provided covering sub-stations and plants which is further connected to overall Earthing Grid. The overall earth resistance (dry) shall be limited to 1 ohm.

12.1.3 Earthing rings shall be provided around sub-stations and plants which in turn shall be connected to the common earthing grid. Minimum size of main grid shall be 75mm×12mm.

Anti-corrosive bituminous paint shall be provided at each joint of earth flat after necessary finishing and priming treatment .

12.1.4 Earth pit shall be maintenance free type (chemical earth pit) considered.

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- 12.1.5 Chemical earth pits shall be considered instead of conventional earth pits in view of faster dissipation of lightning surges and fault currents, easy installation and maintenance free feature. Enhanced high quality UL certified 17.2 mm copper bonded (250 micron) earthing electrode/ rod along with 22.6 KG graphite based (non-bentonite) as a ground enhancing material with stainless steel clamp for connecting copper bonded rod with horizontal flat strip shall be used.
- 12.1.6 Backfill shall be permanent and maintenance free. (No re- charging with salts or any other chemicals) and shall maintain its earth resistance with time. Backfill shall confirm IEEE 80-2000 Clause No.14.5 (d). Backfill in its set form shall have a resistivity of not more than 0.12 ohm-m. Backfill shall comply the requirements and all applicable tests as per part-7 of IEC 62561.
- 12.1.7 Earthing grid/ring shall comprise of buried GI earth strips and GI pipes/electrodes.
- 12.1.8 Separate earth electrodes shall be provided for system neutral earthing. For equipment earthing, minimum two numbers of electrodes shall be provided around each plant/section. However, all these earth electrodes shall be interconnected.
- 12.1.9 Inter-connecting pits having an earth bus in an enclosed brick chamber without earth electrode shall be provided in the common underground earthing grid for convenience of taking earth conductors inside the plants.
- 12.1.10 As far as possible, the reinforcement rods inside concrete column shall be connected to the earthing grid/ring to reduce the overall earth resistance.
- 12.1.11 Individual electrical equipment shall be earthed by GI strip/GI wire/Cu/Al cable. Earth buses shall be provided in plants for earthing groups of electrical/non-electrical equipment to earthing grid/rings.
- 12.1.12 Size of earthing grid/ring and earth conductors of equipment for generating station and sub-stations shall be as per relevant standards. The fault current magnitude shall be decided based on system fault level. The time duration shall be taken as 1 second for voltage level above 66 kV and 3 seconds for voltage upto 66 kV as per IS -3043.
- 12.1.13 All equipment rated above 250 V shall have two external earth connections and those rated up to 250 V shall have one external earth connection. However, for lighting fixtures, earthing shall be done through 3rd core of the cable in safe as well as in hazardous area.
- 12.1.14 Flameproof equipment, in addition, shall have one internal earth connection. This means that 4 core cables to be used for all the flameproof equipments and 3.5 core cables to be used for all flameproof motors located at hazardous area.
- 12.1.15 All steel structures, tanks, vessels, pipes, pipe joints, valves etc. shall be earthed against static charge accumulation by 50x6 mm GI strip. The no. of earth connections shall be as follows:

Equipment having diameter	Hazardous area	Non hazardous area
30 M	2	2
More than 30 M	3	2

- 12.1.16 Wherever process equipments are mounted on steel structures, the structures shall be earthed instead of earthing the individual equipment.
- 12.1.17 The pipe structures shall be earthed at not more than 25M apart.
- 12.1.18 For all equipment in hazardous area, in addition to external earthing one internal earthing shall be provided.
- 12.1.19 Minimum sizes of earth conductors to be used shall be as given below.

Sl.No.	Equipment	GI conductor size	Al conductor Size
1.	HV/LV switch board, transformers,	50mm×8mm	150 sq. mm

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	HV motors		
2.	Motors rated 75 KW and above	50mm×6mm	150 sq. mm
3.	Motors rated 30 KW to less than 75 KW and vessel earthing	35mm×6mm	95 sq. mm
4.	Motors rated 5.5 KW to less than 30 KW	25mm×6mm	25 sq. mm
5.	Motors less than 5.5 KW	8 SWG	6 sq. mm
6.	All minor equipment rated 250V & above.	10 SWG	6 sq. mm
7.	Earth Grid	75mm x 12 mm.	-

Vendor to calculate the actual size. However, higher size of calculated one or above-mentioned size shall be provided.

All GI conductors shall meet the galvanizing requirement as per IS.

- 12.1.20 The main ground grid shall be buried in earth at a minimum depth of 1000 mm below finished grade level unless stated otherwise

12.2 Lightning Protection

- 12.2.1 All structure shall be protected against lightning strokes by suitable lightning protection system to be designed and installed as per IS/IEC-62305.

- 12.2.2 The number of down conductors shall be minimum two.

- 12.2.3 Bare metallic structures shall not have any air termination rods at the top. The earth connections shall be welded to the bottom of structure at 300 mm above floor level. However, tall metallic columns with insulation at top shall be provided with air termination rods. Separate earth electrodes shall be provided for each down conductor of lightning protection. However, these shall be inter-connected with the other electrodes in main grid.

- 12.2.4 Air Terminal

The vertical air terminal rods shall be installed at the roof of buildings to protect these objects from lightning strokes.

The vertical air terminal shall be made of 20 mm dia galvanized steel rod. The projected length of the rod shall be as required to protect the object (on which the rod is fixed) from lightning stroke.

The air terminal rod shall be properly fixed on the top of the building/structure to withstand very high wind pressure. In case the air terminal rod is embedded at the top of roof of building: the portion embedded inside the concrete shall not touch the reinforcement bars and shall be duly insulated from them.

All the vertical air terminal rods shall be electrically connected together by means of horizontal conductors of size 50 x 6 mm galvanized steel flats.

The shielding angle for one vertical air termination shall be 45 degrees. For more than one rod, shielding angle between the rods shall be taken as 60 degrees.

Horizontal air termination (i.e. G.S. Flat conductor) shall be so laid that no part of the rod will be more than nine (9) meters from the nearest roof conductor.

- 12.2.5 Shielding Masts

The shielding mast for lightning protection shall be installed at the top of steel columns cap plates of power house main building.

The shielding mast shall be made of galvanized steel pipe and the height of the same shall be decided considering the zones to be protected.

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Each shielding mast shall be connected to grounding grid by a down conductor 50 x 6 mm. Galvanized steel flat run along the building column. In addition all power house building columns joints shall be electrically bonded.

12.2.6 Down Conductors

The down conductors shall be 50 x 6 mm galvanized steel flats. The connection between each down conductor and earth electrode shall be made via test link located at approximately 1500 mm above ground level.

13.0 CAPACITOR BANKS

13.1 The LSTK Contractor shall ensure that the power factor remains minimum 0.95 lag (inductive) in all the Bus of HV, MV& LV Switchboards.

Suitable capacitor bank shall be designed and installed at 415 V voltage level in the substation.

Capacitor bank at 3.3 kV or 11 kV may also be considered, if required.

The capacitor bank shall utilize the Automatic Power Factor Controllers to maintain the power factor of individual plant. Under no circumstances power factor shall become leading (capacitive) and all necessary protections to avoid this shall be used.

13.2 For all other specifications, refer PC183-TS-0822.

14.0 FIRE DETECTION AND ALARM SYSTEM

14.1 LSTK Contractor shall provide the Fire Detection and Alarm System which shall be an independent system comprising of individual break glass type manual call points, automatic sensors e.g. smoke and heat detectors, main panel, repeater panel, hooter, battery, battery charger and any other hardware.

14.2 The system shall be designed to provide audio-visual indication at the main panel to be located in Control Room and repeater panels shall be provided in fire station.

14.3 The manual call points shall be provided at strategic locations with access along all exit routes and roads.

14.4 Electrical sirens shall be provided to cover entire Rom Coal/Petcoke/Limestone Handling From Railway Siding To Storage Yard'. Hooters and exit lights shall be provided at required locations in the buildings.

14.5 The fire detection system shall be interfaced with fire suppression system.

14.6 Supply, installation, testing and commissioning of above mentioned components/equipment for plant area, substation & control room shall be by the Contractor along with necessary supply and laying of required signals cables.

14.7 The required nos. of MCPs and detectors in substation & control room shall be calculated as per IS norms and contractor shall get approval from client during detailed engineering stage.

14.8 Separate Centralised Fire Alarm & Detection System of entire fertiliser complex shall be provided by Owner. Fire Alarm & Detection System of Rom Coal/Petcoke/Limestone Handling From Railway Siding To Storage Yard shall be hooked-up with the Centralized Fire Alarm System and shall be in LSTK Contractor's scope. All interfacing equipment as well as cabling required for hook-up shall be in LSTK Contractor's scope.

14.9 All cables (including communication cables) shall be armoured type only.

14.10 For all other specifications refer PC183-TS-0826.

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15.0 COAL /PETCOKE/LIMESTONE HANDLING SYSTEM

- 15.1 The Electrical system shall be suitable for the full capacity of Coa/Petcoke/Limestone conveying system.
- 15.2 Suitable switchgears, motors, cabling etc, for these systems shall be as described in the Electrical design philosophy under these headings.
- 15.3 Conveyor Control Panel (PLC based).

The conveyor control panel (CCP) is required to perform the various control operation to obtain the material flow in the desired patterns. LSTK Contractor to develop control schematic diagram, trip/interlock logics and furnish the same for the safe & proper operation of all conveyor motors..

15.4 Emergency Safety Devices

15.4.1 Following emergency safety device shall be provided at the provided at the specified intervals to trip the conveyor under abnormal operating conditions:-

- i. Pull cord switch
- ii. Belt sway switch
- iii. Zero speed switch
- iv. Emergency stop push button
- v. Gravity take up switch
- vi. Chute choking device
- vii. Bunker level indicating device

In addition status of all safety switches on CCP also to be provided.

15.4.2 Pull Cord Switch

- a) The pull card switch shall be installed only on the normal walk way side of each conveyor at an interval of 30 meters with a minimum of one for each conveyor for tripping the conveyor under emergency.
- b) The switch shall be heavy duty type pedestal mounted, enclosed in a dust proof cast aluminium IP-65 enclosure/stainless steel IP-65 enclosure with removable cover, complete with rope clamping arrangement and a set of normally open/normally close contacts rated or open on the operation of deriving shaft through the lever which shall be actuated by pulling the flexible steel wire rope of about 5 mm dia.
- c) The operating position of the switch shall have latches for safety purpose and resetting of the latch shall only possible by local manual operation. The lever shall operate on either side of its normal vertical axis.
- d) The switch shall be provided with sturdy terminal spring to take the tension of 100 meters long steel wire rope. An arrangement for the adjusting the angle of lever on the shaft shall be provided. The switch shall be complete with 1 no. of earthing terminal, double compression type brass nickel coated cable glands, terminal blocks and cable lugs etc. for termination of 3X2.5 sq.mm XLPE insulated armoured and PVC sheathed copper conductor cable. The complete details, of limit switch and assembly sketches shall be furnished.

15.4.3 Belt Sway Switch

15.4.3.1 The belt sway switches shall be provided along with timer (range 2 min. to 15 min.) to stop the conveyor in case of excessive sway in the belt on either side. These shall be mounted on the both side of the conveyor at an interval of 50 meters or minimum one pair for shorter length of conveyor. The switch shall be heavy duty type, enclosed in dust and weather proof cast aluminium IP-65 enclosure/stainless steel IP-65 enclosure.

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15.4.3.2 The switch shall comprise of horizontally mounted spring return type vertical lever which shall be suitable for operation on its neutral vertical axis, a roller fitted on the lever which is suitable to rotate around its vertical axis. The resetting of the switch shall be possible by local manual operation. The switch shall be complete with a set of normally open/normally close contacts rated for 10 Amps, 240V A.C for alarm and trip. 1 no. earthing terminal, double compression type cable glands suitable for 3x2.5 sq. mm (Cu) XLPE insulated armoured control cable, cable lugs, terminal block etc. The complete details of switch and assembly sketch shall be furnished.

15.4.4 Zero Speed Switch

- a) The zero speed switch with timer of suitable range shall be required to provide adequate protection to conveyor against the following:-
 - Excessive belt slip and belt under speed.
 - Belt breakage or snapping
- b) The switches shall be provided one per conveyor. The switches shall be heavy duty type enclosed in dust and weather proof cast aluminium IP-65 enclosure/stainless steel IP65 enclosure. The switch shall be turn on mounted type having centrifugal switch chamber on one side and extended rotating spindle with pulley at other end.
- c) The pulley mounted on the spindle shall be so designed that it shall be able to rotate with the friction against the belt surface with as minimum slip as possible. The arrangement shall be provided to adjust the belt speed within the desired limits. This shall be mounted on the tail end side of the conveyor.
- d) The switch shall be complete with a set of normally open/normally close contacts rated for 10 Amps, 240V AC, and 1 no. earthing terminal, double compression cable glands, suitable for 3X2.5 sq.mm copper conductor XLPE insulated armoured control cable, cable lugs, terminal block etc. The complete details of the switch and assembly sketches shall be furnished.

15.4.5 Emergency Stop Push Button

- a) The stop push button shall be provided in staggered manner at an interval of 20 meters with a minimum of one on each side of conveyor for tripping the conveyor under emergency.
- b) The push button shall be heavy duty type enclosed in dust and weather proof cast aluminium enclosure / SS enclosure and shall be suitable for wall/structure mounting.
- c) The push button shall be red colored, un-shrouded type having a set of normally open/normally closed contact rated for 10 Amps, 240V AC and shall have padlocking facility. The push button shall be complete with 1 no. earthing terminal, double compression type cable glands suitable for 3X2.5 sq.mm copper conductor XLPE insulated armoured control cable, cable lugs and terminal block etc.

15.4.6 Steel Wire Rope & 'U' Clamps

- a) Galvanized steel wire rope shall be 6/19 construction, ordinary right hand lay, 5 mm dia. conforming to IS-3459 and provided with PVC sleeve of suitable thickness.
- b) The steel wire shall be provided all along with conveyor with one end tied to 'U' clamp and other end to lever of pull cord switch Steel 'U' clamp fabricated out of 50X7 flats, complete with all nuts & bolts for fixing 5 mm dia. galvanized steel wire rope. The 'U' clamp shall be duly painted to withstand the corrosive chemical atmosphere prevailing inside the conveyor gantries due to urea dust.

15.4.7 KLAXON

- a) Electric Klaxon, heavy duty type, enclosed in a dust and weather proof cast aluminium epoxy painted enclosure, suitable for still air range of 250 meters and rated for half hour at 240V single phase 50Hz AC supply.

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- b) The Klaxon shall be provided all along with conveyor at an interval of 100 meters apart with a minimum of 1 per conveyor and 1 per transfer tower and at any convenient location to sound the alarm before the start up of plant.

15.4.8 Other Electrical Items

All other electrical items shall be suitable for the duty involved and service Conditions.

16.0 MOUNTING STRUCTURES

Switch sockets, cable trays, DBs etc shall be mounted / supported on suitable structure fabricated out of standard sections of mild steel, i.e. channels, angels, flats etc conforming to IS: 2066.

17.0 SPARES

17.1 Commissioning Spares

The commissioning spares shall form an integral part of the scope of supply. Contractor shall be responsible for the quantification of the commissioning spares for the smooth commissioning start up of the plant/ package system. Item wise list of commissioning spares with recommended quantity shall be furnished for information. The same shall be Part of LSTK price

17.2 2 years operational spares (Mandatory)

Contractor shall supply Mandatory spares for all equipments as per Section VI-6.0: Spare Parts of NIT. The same shall be Part of LSTK Price.

17.3 Recommended Spares (Other than Mandatory spare)

Contractor shall provide recommended spares (other than mandatory spare) for all the equipment (item-wise) with recommended quantity.

17.4 All spare parts shall be identical to the parts used in the equipments.

17.5 Any other spare parts or special tools not specified, but required, shall also be provided. The same shall be part of LSTK Price.

18.0 VENDORS' SERVICES

18.1 The LSTK Contractor shall consider the services of major equipment suppliers during installation, testing and commissioning in their scope as required.

18.2 The services of engineers of following equipments' (OEM)manufacturers are envisaged and required during installation, Testing and commissioning. LSTK contractor shall arrange for the same without any additional cost implication:

- AC UPS
- Variable Speed Drives
- Numerical relay
- HV & LV Switchboard
- Fire Detection & Alarm System

18.3 Site Testing, parameterization and commissioning of the Numerical relays shall be done by OEM expert only.

19.0 TESTING & INSPECTION

19.1 Testing of all electrical equipments shall be done in accordance with relevant IEC/BIS codes in presence of owner's representative at manufacturer's works before despatch / at site before installation. All such tests shall be arranged by the contractor and testing charges, if any, shall be borne by the contractor.

19.2 The LSTK Contractor shall submit the certificates of type tests performed on identical equipment as evidence of the compliance of the equipment with the type tests. All Type Test Certificates shall not be older more than 5 years except GIS for which Maximum 10 years old Type test Certificates is acceptable subject to no change in Design.

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- 19.3 The LSTK Contractor shall submit the certificates of routine and acceptance tests conducted on the purchased equipments.
- 19.4 All the routine/acceptance tests shall be performed at the manufacturer's works in the presence of owner's representative.
- 19.5 Stage Inspection of Electrical Equipment shall be considered. The owner or their representative shall be allowed to visit the manufacturing works for stage inspection during manufacturing stage.
- 19.6 The equipment shall be dispatched from works only after receipt of Owner written approval of the test reports.
- 19.7 The LSTK Contractor shall intimate the owner 4 weeks in advance of the tests and submit the detailed schedule of tests.
- 19.8 In addition, the equipment shall be inspected at site for final acceptance.
- 19.9 Certified reports of all the tests carried out at the works shall be furnished in six (6) copies for approval of the Owner.
- 19.10 Electrical installation work shall be subjected to inspection by owner / his authorized representative, statutory bodies like Electrical Inspector, Factory Inspector and where applicable by equipment supplier's engineer. The contractor shall carry out without extra cost to owner rectifications / modifications desired by the above authorities to make the installation conforming to I.E. Rules etc.
- 19.11 The owner may reject any portion of the work considered defective or of poor workmanship and the contractor shall make good these defects without extra cost to owner.

20.0 DOCUMENTATION

- 20.1 The LSTK Contractor shall submit the documents for electrical equipments (MS-word, MS-excel and AutoCAD) as per the drawing and documentation schedule as given in this bid package.
- 20.2 Sizing of Electrical system and Equipments shall be submitted during detailed engineering stage.
- 20.3 LSTK Contractor shall ensure that following shall be mentioned in each sheet of drawings/ documents in the order mentioned below:
- (a) Logo and Name of the client
 - (b) Logo and Name of the consultant
 - (c) Logo and Name of the contractor (LSTK Contractor)
 - (d) Logo and Name of the Manufacturer on the drawings prepared by manufacturer, if applicable
 - (e) Name of the Project for which drawings are applicable
 - (f) Title of the drawing (Title shall indicate the details shown in the drawing)
 - (g) Drawing/ document number with sheet number and number of total sheets in the drawing (Drawings having different title shall be assigned different drawing number)
 - (h) All sheets of each drawing shall bear same title, same document number and same revision number
- 20.4 At the time of handing over of the installation, LSTK Contractor shall supply as built drawings taking into consideration the actual execution carried out at site.
- 20.5 Erection, testing/ checking (inclusive of calibration check) prior to energisation/ after energisation and commissioning Manuals shall be in bound book format and shall give step by step procedure for:

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- (a) Storage, Handling and Erection
 - (b) Checking/ testing after erection and before energisation.
 - (c) Pre-commissioning tests/ checks and cold trials
 - (d) Commissioning
 - (e) Drawings relevant for erection, operation, maintenance and repair of the equipment.
 - (f) List of instruments/ testing kits/ sets, measuring instruments etc. required for testing/ checking with specification, ratings, ranges etc.
- 20.6 Operation & Maintenance Manuals for each of the equipment/ system being shall be in bound book format and shall be supplied alongwith dispatch of equipment and inclusive of following:
- (a) Log sheets indicating daily/ hourly recordings of parameters to be noted down by customer's operating personnel.
 - (b) Procedure for shut down and energisation.
 - (c) Preventive maintenance schedule.
 - (d) Safety procedures for safe operation of equipment and complete system.
 - (e) Specification of equipment installed. Manufacturer's catalogues operation and maintenance manuals for all types of relays/components used.
 - (f) Test procedures for site tests/ checks.
 - (g) Spares list for each equipment/ system for 2 years operation and maintenance.
 - (h) Relevant calculations and protection relay setting table for the equipment/ system being supplied by him
 - (i) Instructions for Diagnostic trouble shooting / fault location charts
 - (j) Tests for checking of proper functioning/ Operation.
 - (k) Storage and re-conservation Manual
 - (l) Safety Manual
 - (m) Drawings relevant for operation, maintenance and repair of the equipment
 - (n) Instructions for Maintenance and Repair
 - (o) List of spare parts with ordering specifications and manufacturer's catalogues.
 - (p) List of consumables with specifications, brand names and annual consumption figures.
 - (q) Manufacturer's catalogues with ordering specification for all items
 - (r) List of special tools and tackles
 - (s) QAP, Internal Test Certificates and Inspection Certificates
 - (t) Procedure for ordering spares.
 - (u) All as built drawings.
- 20.7 Drawings/ documents to be submitted with inspection call of equipment:
- (a) Type test certificate for identical equipment
 - (b) Sub-supplier's/ vendor's catalogue/technical literature
 - (c) Test reports for internal inspection
 - (d) Test certificates of components
 - (e) Technical specification & data sheets of equipment

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(f) All drawings as applicable of category 'Approved', 'Approved with comments' and drawings 'For information/ Reference' including comments thereon

20.8 The details of equipment layout and cable routing will be designed by the LSTK Contractor during detail engineering stage and these shall be subject to approval by Owner/Consultant. Changes as required to achieve a neat layout with adequate working space all around, for better aesthetics as well as to meet statutory regulation and codes shall be done without any time and cost implication.

21.0 TOOLS & TACKLES

The LSTK Contractor shall supply at least one set of all special tools for each substation required for maintenance of the equipment supplied by them and price shall be included in the offer. List of tools & tackles with quantities shall be mentioned in the offer.

22.0 REVIEW OF DRAWINGS & DOCUMENTS BY OWNER/ CONSULTANT

22.1 The successful Bidder (herein after referred as contractor), shall submit within one month of placement of LOI; list of drawings/ documents/ Manuals that would be submitted by them. The list shall mention Serial Number, Title of the drawing/ document/ manual, Category (For Approval, For review, For Reference, etc) and tentative date of submission. The list shall be prepared taking in to account into consideration stipulations in respect of submission of drawings/ documents and scheduled date for completion.

22.2 Template for name plate of drawings, documents and drawing/ document numbering system shall also be submitted by contractor and approval obtained.

22.3 The LSTK Contractor shall ensure that all sheets of the drawings/ documents and top sheet of manual prepared by manufacturer/ vendor/ supplier & submitted by him or by his consortium member or by manufacturer or his consultant, are checked by him/ leader of consortium and vetted by LSTK Contractor / Leader of consortium before submission with stamp ensuring correctness, completeness, suitability of document for subject work and compliance with stipulations of order

22.4 The responsibility for delay in approval/ review of drawings/ documents due to

- a. Submission of incomplete drawings/ documents not meeting the requirement of project/ stipulations of order
- b. Non-compliance of comments made earlier
- c. Drawings are not submitted in requisite copies;
and consequent delay in project shall be that of contractor.

22.5 The contractor shall ensure that in case any model number is mentioned in the drawing, detailed technical catalogue, literature, explanatory notes to describe the model and its technical details in full are also submitted along with the drawing. Such drawings/ documents should be assigned Drawing/ Document Number, Number of sheets in the drawing, Rev number etc (Unique Identification). Reference of such drawing/ document number should be mentioned in the drawing.

22.6 The drawings/ documents shall be prepared in such sizes that those can be read easily. Size of font in print submitted shall not less than size10 Arial or equivalent.

22.7 The drawings/ documents shall be submitted in sizes in which those are prepared. Photocopies in reduced sizes shall not be accepted.

22.8 The contractor shall leave space on each sheet for stamping the drawing by Owner/ consultant to avoid stamping on contents of drawing making them unreadable. Submission of drawings in A4 size shall be avoided.

22.9 All sheets of a drawing shall be assigned same title and drawing number. Drawings having different title shall be assigned different drawing numbers.

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- 22.10 GA drawings, schematic diagrams, single line diagrams, bill of material, data sheets, characteristics curves, cable schedules and cable termination diagrams shall be assigned separate drawing numbers.
- 22.11 Revision shall be clearly marked on all subsequent issue of drawings and documents.
- 22.12 Inability to incorporate some of the comments shall be clearly stated by contractor with reasons and without delay. However, to accept or reject the non-compliance based on the reasons indicated by contractor shall be discretion of Owner/ their consultant.
- 22.13 In case alterations are considered necessary by the contractor in the drawings already approved, such drawings shall be resubmitted for approval again stating the considerations necessitating changes/ alterations. In case, alterations/ changes proposed by contractor are approved by the consultant/ Owner; all other drawings and data affected by such alterations/ changes shall be duly revised and re-submitted for the approval as stated above.
- 22.14 Contractor shall depute their concerned engineers (with the engineers of suppliers, if required) shall visit consultant after submissions of drawings for discussion, modification of drawings and approval so that project is not delayed for want of approval of drawings.
- 22.15 It will be the responsibility of contractor to submit the drawings and obtain approval to meet the project schedule. Delay in approval of drawings due to following shall be the responsibility of contractor:
- a. non-submission of drawings/ documents/ well before those are actually required and/ or
 - b. delay in incorporation of comments and/ or
 - c. non-incorporation of comments by contractor and/ or
 - d. submission of drawings without checking and ensuring requirement stipulated in contract/ order
- 22.16 Contractor shall note that any approval and/ or clearance accorded by Owner or consultant for manufacture and/ or to proceed further given during discussions or recorded in the minutes of the meetings shall be valid only after the drawings showing relevant details are submitted by contractor and clearance/ approval is accorded by Owner/ Consultant by stamping and signing on the relevant drawings.
- 22.17 Approval of drawings by Owner / his consultant shall not relieve the contractor of his contractual obligations and responsibility for engineering, design, workmanship, materials and performance of the equipment
- 22.18 Contractor shall furnish, if requested, additional drawings, calculations, information to the Owner/ Consultant to enable him to examine/ study the drawings submitted.
- 22.19 Contractor shall note that work shall be carried out exactly as indicated in the approved drawings and no alterations shall be made without the written approval of the Owner/ Consultant.

23.0 TRAINING

- 23.1 Training shall be imparted to owner's personnel at manufacturer's works as under:
- a) AC UPS: Two engineers for one week .
 - b) Variable Speed Drive: Two engineers for one week.
 - c) Numerical relay: Two engineers for one week
 - d) HV & LV Switchboard : Two engineers for one week
 - e) Fire Detection & Alarm System : Two engineers for one week

24.0 VENDOR LIST

- 24.1 Make of all electrical equipment shall be as per Section VI-10.0: Vendor List attached with this NIT.

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- 24.2 Any other vendor shall be subject to Owner/Consultant's approval.
- 24.3 Any other item for which vendors are not mentioned in NIT, LSTK Contractor shall furnish list of proven suppliers with PTR subject to Owner's/ Consultant's approval during detailed engineering. Document(PTR) shall be in English language only.

25.0 INSTALLATION, TESTING AND COMMISSIONING

- 25.1 The LSTK Contractor shall undertake installation of all electrical equipment in accordance with latest code of practices, in conformity with recommendation of the respective equipment manufacturers, drawings approved by the owner or owner's representative, direction of engineer-in-charge, statutory regulations and to the entire satisfaction of the owner.
- 25.2 The LSTK Contractor shall arrange all the necessary erection tools and tackles, testing and measuring instruments and shall supply the required erection materials including structural steel.
- 25.3 LSTK Contractor shall furnish field inspection and test data sheets for all equipments for owner's approval.
- 25.4 The LSTK Contractor shall obtain the necessary certificate of compliance/completion certificate with test results from statutory authorities as required. All necessary drawings and test certificates as required by them shall be furnished by the vendor.
- 25.5 The erection work shall be supervised by competent supervisors holding relevant supervisory license from the Government.
- 25.6 Installation of Equipment
- The equipment shall be installed in switchgear rooms, MCC rooms, control rooms and at shop floors.
 - The scope of work of LSTK Contractor under installation shall be inclusive of but not limited to the following:
 - Physical inspection and handling
 - Assembly and interconnection of shipping sections, if any, as per manufacturer's instructions. Supply of materials, fabrication and installation of supporting frames/ brackets for proper support of equipment/ panels/ devices/ cable trays etc..
 - Installation on foundation/ supports/ brackets.
 - Alignment, levelling and clamping/ welding/ fixing/ grouting with supports/ foundation bolts as required.
 - Mounting loose supplies and connection of wiring.
 - Conducting pre-energisation tests/ checks to ensure that installation is carried out as per manufacturer's instructions/ direction of supervising engineer and is healthy/ fit for energisation.

25.7 Cable Installation

25.7.1 General

- All Cables to be laid in overhead cable tray only. Cable Tray for HV, LV and Control cable should be separate. Underground cable to be avoided, Cables to be laid on racks in underground concrete cable trenches inside the plant only where overhead structure is not possible. Cables may be laid in ground (slit with HDPE conduit) where number of cables to be laid are less and do not justify use of concrete cable trenches.
- All the cable tray structures shall be painted with two coats of primer and two coats of final paint after necessary surface preparation.

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- (c) Cable OD 40 MM and above shall be clamped individually.
- (d) Cables shall be clamped only after the cables are neatly arranged, dressed tailored and kept in position. Support of cables on edges of cable trays/ structural steelwork shall be avoided.
- (e) Power cables shall be laid in one layer only. Control and other cables may, however, be laid in two layers. More than two layers shall not be permitted.
- (f) All the cable tray network shall be earthed by a continuous earth strip.

25.7.2 Cable laying in Trench/ on Racks/ Trays/ Cleated on Wall/ Structure. For proper support, access and neatness of appearance of installation; cables shall be laid on racks or cable trays or cleated on wall and/ or structure taking following into consideration:

- (a) Cable racks/ trays shall be 250 mm apart.
- (b) Ladder type cable trays shall be used for laying power cables.
- (c) Perforated type cable trays shall be used for laying control, signal, and communication etc. cables.
- (d) Coaxial cables for data transfer from/ to microprocessor based equipments shall be laid in HDPE conduits with pull boxes fixed to cable supporting racks.
- (e) Top tray shall be used/ left vacant for communication, signalling and fire alarm cables.
- (f) Cables shall be laid in separate trays according to voltage and noise classification. Fire proof partition shall be provided between HV and LV cables.
- (g) Power, control and lighting cables shall be laid in separate cable trays.
- (h) Large size cables shall be clamped individually. Small size cables may be bunched together provided that in any bunch all cables have sheath of same material.
- (i) Cables in trays shall be clamped at not more than every 1500 mm for horizontal run and 800 mm for vertical run and near bends.
- (j) Cable racks/ trays shall be planned in such a way so that at least 20 % or one rack/ tray (whichever is more) can be added in future and at least 20 % free space shall be left in each cable tray for cable laying in future..
- (k) Support to cable trays shall be provided at intervals as required for proper support but at interval not more than 1000 mm.
- (l) Support to trays shall also be provided at each joint of tray irrespective of its distance from adjacent support.
- (m) GI trays shall be fixed using nuts and bolts as welding will not be permitted.

25.7.3 Cable laying in conduits

- (a) Cables shall be laid in GI conduits while laying on or crossing floors/ wall/ railway lines/ roads.
- (b) While laying on floor or wall or crossing roads conduits shall be embedded in concrete/wall.
- (c) When laid on floor the top cover shall be minimum 10 mm.
- (d) At rail/ road crossings, the conduits shall be laid not less than 1 meter below top surface of the road.
- (e) Mechanical protection by G.I. Pipe shall be provided to all cables up to 1200 mm from ground/ floor level.
- (f) Minimum diameter of G.I. pipes used for laying/ protection of cables shall be 1.6 times the cable diameter.

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- (g) Only one cable shall be laid in one conduit.
- (h) Conduit shall be sealed after cable laying.
- (i) Standard bends or fabricated bends shall not be used. wherever required, conduits shall be bent using bending machine. Bending radius shall not be less than 10 times the diameter of conduit.
- (j) Jointing of the conduits shall be done using sockets which may be welded from top to avoid ingress of water.
- (k) Ends of conduits shall be made smooth to avoid damage to cables.

25.7.4 Cable Jointing

- (a) Joints in cable length less than standard drum length shall not be allowed.
- (b) Joints, if unavoidable, shall be made at most suitable places.
- (c) Joints shall not be made at passageways or under rail/ road crossings and in hazardous area.
- (d) Joints shall be segregated by not less than 2 meters so as to reduce the possibility of one joint failure affecting the other.
- (e) Individual cores in cables shall always be joined number to number or colour to colour of the insulation over the conductors.
- (f) Continuity and current carrying capacity for earth conductor and/ or armour shall be provided.
- (g) Cable jointing shall be done by joiners who possess certificate of competency for carrying out particular joint.
- (h) Minimum 2 meters cable loops shall be kept near each joint.

25.7.5 Cable Termination

- (a) Double compression heavy type glands/ heat shrinkable termination kits and bi-metallic/ copper lugs shall be used for termination of cables.
- (b) Paint of the gland plate at the contact point of gland shall be removed for proper contact.
- (c) Cable glands/ termination kits shall be earthed.
- (d) Cables to individual cubicles shall be neatly laid out and supported.
- (e) Cables shall be clamped at a distance of 400 mm from gland/ termination.
- (f) Conductors of control cables shall be neatly arranged in compact group. The entire group shall be placed and tied with nylon straps.
- (g) Spare cores shall be terminated with sufficient length to permit future connection to the terminal block associated with control cables.

25.7.6 Identification

- (a) Cable tags shall be made of non- corrodible material, preferably SS.
- (b) Voltage, cable number etc shall be engraved on each tag.
- (c) Cable tags shall be tied to each cable at
 - (i) All termination (outside as well inside panel/ box.)
 - (ii) All bends.
 - (iii) All points before and after which their route cannot be easily identified.

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- (iv) Entry and exit from conduits.
- (v) All joints.
- (vi) Every 15 meter for straight run.

26.0 TESTING OF INSTALLATION AFTER ERECTION

- 26.1 The LSTK Contractor shall carryout tests/ checks after erection of equipment/ cables to check, ensure and demonstrate the conformity of equipment supplied and installation done with the specification and statutory requirement.
- 26.2 Prior to starting the test, the LSTK Contractor shall satisfy himself and ensure that
- a. The installation is strictly in accordance with the specification, drawings and statutory requirement.
 - b. Any automatic controls that might vitiate the tests have been relaxed.
 - c. All instruments to be used for testing are suitable for the purpose and have been calibrated by a recognised laboratory within the last 12 months and copy of the calibration certificates have been submitted to the Owner/ Consultant.
 - d. The testing, commissioning, operation and maintenance manuals are available to the testing engineer and Owner/ Consultant.
 - e. Formats for recording test results have been finalised with the Owner/ Consultant and copies have been distributed to all concerned.
- 26.3 The skilled manpower to test all the equipment, cables, earthing etc deputed by LSTK Contractor is well aware of and prepared to perform checks/ tests.
- 26.4 The tests shall be witnessed by the representatives of Owner/ Consultant.
- 26.5 The LSTK Contractor shall compile and tabulate all the test results in agreed formats and submit to Owner/ Consultant for approval prior to acceptance of installation.
- 26.6 Testing and checking shall be carried out to demonstrate and record prior to completion, that supply and installation meets the requirement/ performances specified. The installation shall be tested in presence of Owner/ Consultant.
- 26.7 The LSTK Contractor shall give at least 24 hours notice to Owner/ Consultant to enable them to witness the test.
- 26.8 The LSTK Contractor shall submit to Owner/ Consultant test record sheets on daily basis.
- 26.9 Equipment or any part of the installation shall be energised only after all pre-energisation tests are completed and test results are approved by Owner/ Consultant.
- 26.10 Failure to submit test results as tests are completed may render the LSTK Contractor for carrying repeat tests.
- 26.11 The LSTK Contractor shall supply six (6) bound and indexed copies of all tests in agreed formats prior to preliminary acceptance and handing over of the equipment/ installation, duly signed by representatives of the Owner/ Consultant who have witnessed the tests.
- 26.12 It will be the responsibility of the LSTK Contractor to supply/ arrange at his own cost all necessary testing equipment and measuring equipment required for conducting the tests as per applicable standards.
- 26.13 Should any of the tests reveal any discrepancy or non-conformity, the same shall be attended to and retested before proceeding with any other tests.
- 26.14 All tests shall be conducted in accordance with this specification, standard specifications of Bureau of Indian Standards, recommendations of IEC and IE Rules.
- 26.15 Tests checks to done at site shall be inclusive of but not limited to the following:

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- | | | | |
|-----|---|---|--|
| a. | Physical Check & Verification | : | All Equipment/Cables etc |
| b. | Tightness of connections | : | All Equipment/Cables etc |
| c. | Checking for cleanliness | : | All Equipment/Cables etc |
| d. | Size & No. of Earth connection | : | All Equipment/Cables etc |
| e. | Erection, alignment, mounting height and clearances | : | All Equipment/Cables etc |
| | | | |
| f. | Insulation Resistance test | : | All Equipment/Cables etc |
| g. | Earth continuity test | : | All Equipment/Cables etc |
| h. | Earth Resistance test | : | All Equipment/Cables etc |
| i. | Earth loop impedance test | : | All Equipment/Cables etc |
| j. | No load & rated load current | : | All Motors/ Loads |
| k. | No load & rated load P.F. | : | All Motors/ Loads |
| l. | No load & rated load Power | : | All Motors/ Loads |
| m. | Functional checks | : | All Equipment & Controls |
| n. | Primary injection test | : | All switchgear |
| o. | Secondary injection test | : | All protective relays/ devices |
| p. | Ratio and polarity test | : | CTs |
| q. | Power frequency HV test | : | Power & Control circuit |
| r. | Phase sequence checks | : | /C & bus couplers |
| s. | Winding resistance test | : | Motors & Transformers |
| t. | Direction of rotation | : | All motors |
| u. | Free running for 2 Hrs | : | All motors |
| v. | Under voltage tests | : | All U/V Devices |
| w. | Calibration Checks | : | All instruments |
| x. | Load and Performance tests | : | UPS, PLC, & Variable Frequency equipment, Battery Bank |
| y. | Checking of Voltage, current | : | UPS, PLC, & Variable Frequency equipment |
| z. | Checking of specific gravity and acid level | : | Battery |
| aa. | Illumination levels | : | All areas |

26.16 It is anticipated that following equipment will be necessary to perform testing of the installation. The LSTK Contractor shall, therefore, arrange these as well as any other equipment for testing of the installation.

- a. HV Testing Set
- b. Primary Injection Set
- c. Secondary Injection Set
- d. IR Testers
- e. Earth Continuity testers

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- f. Soil resistivity Testers
- g. Earth resistance Testers
- h. Phase to earth loop impedance testers
- i. Milli volt drop testers
- j. Micro-ohm meter
- k. Phase sequence testers
- l. Clip-on ammeters
- m. Voltmeters
- n. Power factor meter
- o. Frequency meter
- p. 3 Ph 4 wire unbalance load kWh meter
- q. Cable fault location equipment
- r. Digital multi-meter suitable for testing IC voltage and current levels
- s. Analogue Multi-meters
- t. Portable multi-range precision ammeters, voltmeters complete with CTs, PTs for AC/DC circuits.
- u. Protection relay test plugs
- v. Portable earthing equipment
- w. Dual beam oscilloscope with storage facility.
- x. UV recorder
- y. Illumination level meter
- z. Thermometers
- aa. Power Analyser / Portable Power Meter
- bb. Rpm meter
- cc. Noise meter

26.17 At least following tests shall be specifically conducted before commissioning in presence of owner's representative. All the test results shall be recorded and submitted to the owner.

- a) Insulation Test
- b) Continuity Test
- c) High Voltage Test
- d) Simulation Test
- e) Earth Resistance Test

27.0 QUALITY ASSURANCE

- 27.1 All equipment, components, materials proposed to be supplied by LSTK Contractor shall be procured, manufactured, erected, commissioned and tested as per a comprehensive Quality Assurance Programme (QAP) to be approved by the Owner/ Consultant.
- 27.2 The Successful Bidder shall submit within 1 Month of from order; Quality Assurance Plan (QAP) for all the equipment/ panels/ cables/ motors/ devices etc. under their scope of supply.
- 27.3 All routine and acceptance tests shall be carried out as per relevant IS / IEC/ Other Standards during inspection at manufacturer's works in presence of Owner or his representative.

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- 27.4 The LSTK Contractor shall submit type test certificates for similar equipment supplied by him elsewhere. In case type test certificates (not more than 5 years old and conducted at duly accredited laboratory) for similar equipment is not available, the type test shall be conducted in presence of Owner or his representative without any financial implications to Owner.
- 27.5 The inspection procedure shall be finalized and approved by Owner and/ or their consultant/ authorized representative.
- 27.6 Inspection will be carried out as per drawings and quality assurance plan approved by the Owner/ Consultant. Inspection shall be carried out either at manufacturer's shop/ works or any other place where facilities for conducting tests/ checks are available.
- 27.7 Owner reserves the right to witness any of the tests and verify the documents of the LSTK Contractor , his supplier/ vendor/ manufacturer.
- 27.8 Manufacture test certificate for bought out components shall be submitted during inspection.
- 27.9 No equipment or part items shall be dispatched without final acceptance certificate and dispatch instructions in writing issued by Owner and/or their authorized representatives.
- 27.10 The LSTK Contractor shall carry out an inspection and testing programme during manufacture in his works and/ or that of his vendor's works to ensure accuracy/ correctness/ completeness of components, compliance with drawings, conformance to functional and / or performance requirements, identify and acceptability of all materials, parts and equipment. The LSTK Contractor shall also carry out all tests/ inspections required to establish that the items/ equipment conform to requirements of the specification and the relevant codes/ standards specified in the specification in addition to carrying out tests as per the approved Quality Plan.
- 27.11 Quality audit/ surveillance/ approval of the results of the tests and inspection, approval of drawings will not, however, prejudice the right of the Owner to reject the equipment at any subsequent stage if it does not comply with the specification or does not give complete satisfaction in service and shall in no way limit the liabilities and responsibilities of the LSTK Contractor of ensuring complete conformance of the materials/ equipment supplied to relevant specification, standard, data sheets, drawings etc.
- 27.12 The owner or their representative shall be allowed to visit the manufacturing works for stage inspection during manufacturing stage.
- 27.13 The LSTK Contractor shall intimate the owner 4 weeks in advance of the tests and submit the detailed schedule of tests.
- 27.14 LSTK Contractor s shall supply reports of type tests, acceptance tests, all requisite factory tests and site tests in bound volumes.
- 27.15 All the equipment shall be tested at site to know their condition and to prove suitability for energisation and required performance.
- 28.0 COORDINATION WITH OTHER CONTRACTORS**
- 28.1 LSTK Contractor shall coordinate with Owner's other Contractors and shall freely exchange all technical information required for this purpose.
- 28.2 All civil works connected with electrical installation shall be under the LSTK Contractor's scope.

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ANNEXURE-I

ILLUMINATION LEVELS

Average illumination levels (Mean Lux) for various areas shall be as follows:



SI. No.	AREA	LUX
1.0	<u>ROADS</u>	
1.1	Plant roads	20
2.0	<u>YARD</u>	
2.1	Marshalling yard	20
2.2	Loading/unloading areas	50
2.3	Open areas	20
3.0	<u>PLANT</u>	
3.1	Operating platforms	100
3.2	Non-operating platform/ general process areas & walk ways	50
3.3	Pipe rack	100
3.7	Area near large rotating equipment/plant	200
3.8	Air Conditioning Plant Room	200
3.9	Elevator machine Room	200
4.0	<u>SUB-STATION</u>	
4.1	Switch room - Front of panel	250
	- Back of panel	150
	- Battery room	150
4.2	Transformer room, cable room.	70
4.3	Outdoor/transformer bay	70
5.0	<u>CONTROL ROOMS</u>	
5.1	Front of panel	500
5.2	Back of panel	200
6.0	OFFICES	300
7.0	<u>STORES, BATH ROOM</u>	100
8.0	<u>STAIR CASES</u>	
8.1	Safe areas	100
8.2	Hazardous areas	100
9.0	<u>PANIC LIGHTING</u>	10

Lux level for A.C. Emergency lighting in Control Room shall be 250 lux.

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TECHNICAL SPECIFICATION

UNINTERRUPTED POWER SUPPLY

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2.0	STANDARDS TO BE FOLLOWED
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4.0	DESIGN AND OPERATIONAL REQUIREMENTS
5.0	CONSTRUCTIONAL DETAILS
6.0	COMPONENT DETAILS
7.0	OPTIONAL ITEMS
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10.0	DRAWINGS AND DOCUMENTS
11.0	SPARES
12.0	PACKING
ANNEXURE - I	DOCUMENTATION FOR UNINTERRUPTED POWER SUPPLY
ANNEXURE - II	METERING INDICATIONS AND ALARM SCHEDULE

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1.0 SCOPE

- 1.1 The specification covers the design, manufacture, testing at works and despatch in well packed condition of Uninterrupted Power Supply System required to supply AC power for non linear loads (i.e. instrumentation loads).
- 1.2 This standard shall be read in conjunction with block diagram & UPS distribution diagram.
- 1.3 The scope shall include the following:
- i) Full wave controlled rectifier
 - ii) Inverter
 - iii) Static switches
 - iv) Storage battery
 - v) Static voltage stabilizer for bypass supply
 - vi) Manual bypass switches
 - vii) Isolation / output transformer to achieve desired output voltage
 - viii) UPS Distribution Boards
 - ix) Interconnecting cabling between various units of UPS
 - x) All other items required, but not specified for safe and reliable operation of UPS system.

2.0 STANDARDS TO BE FOLLOWED



- 2.1 The equipment shall conform to the latest issue of the following and relevant Indian Standard specifications Equipment complying with equivalent IEC standards shall also be acceptable.
- | | |
|----------|--|
| IS-13314 | - Solid state inverters run from storage batteries |
| IS-11260 | - Stabilized power supplies AC output |
| IEC-146 | - Solid state inverters |
- 2.2 The equipment shall also conform to the provision of Indian Electricity Rules, Indian Supply Act and any other statutory regulations in force from time to time.

3.0 AMBIENT CONDITIONS & ELECTRICAL SYSTEM CHARACTERISTICS

These shall be as specified in the enclosed Design Philosophy - Electrical.



4.0 DESIGN AND OPERATIONAL REQUIREMENTS

- 4.1 The UPS unit and its associated equipments shall be suitable for operating at the specified rating continuously with the specified voltage and frequency variations under the ambient conditions without exceeding the temperature rise limits specified in relevant standards and without any detrimental effect on any part.
- 4.2 The UPS system shall be based on latest generation of IGBT based, pulse width modulated (PWM) design with proven performance. The basic scheme required for UPS system shall be as indicated in Block diagram in this specification.
- 4.3 The UPS shall have Redundant Scheme with Bypass. Under normal operating conditions, both inverter units should run in parallel sharing 50% load in synchronism with by-pass power and supply uninterrupted A.C. power to load. On failure of one of these inverters, the faulty inverter should get automatically disconnected from the load and healthy inverter should supply 100% load in synchronism with by pass supply. In

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the event of second inverter also developing a fault, a no-break load transfer to standby power supply should take place through static switch.



- 4.4 Output frequency of the inverters must remain synchronised to one another which in turn shall be synchronised to the standby power supply frequency provided the latter does not vary by more than +3% to -5%. It should be possible to change the setting of frequency range of synchronism between above limits by frequency selector switch. Outside these limits inverter should desynchronise with the bypass and run at its own frequency. When running at its own frequency, frequency variation shall be maintained less than $\pm 1.0\%$. Resynchronisation with bypass power supply must take place automatically with some time delay when frequency comes back to +3% to -5% range. Change-over from inverter to bypass or bypass to inverter shall also be possible in desynchronised mode of operation. Change-over time in both synchronised and desynchronised mode operation shall be indicated.
- 4.5 The UPS unit shall be suitable for 0.7 lagging to unity power factor. The overall power factor may be taken as 0.8 lagging.
- 4.6 The maximum waveform distortion of the output voltage shall not exceed 5% r.m.s. for linear loads and 10% r.m.s for non-linear loads. The UPS unit shall be suitable for operation for non-linear loads having crest factor of 3.
- 4.7 The inverter steady state output voltage and frequency (free running) variation shall not exceed $\pm 1\%$ for specified input power supply condition and no-load to full load condition.
- 4.8 Voltage dip / rise on sudden application / throw of 100% load or on changeover from inverter to bypass or vice versa shall not exceed 15% and shall be recovered within 100 m. sec. to rated voltage.
- 4.9 UPS shall be designed for overload of 125% for 10 min. and 150% for 10 sec. after which drooping characteristic shall come into operation.
- 4.10 On failure of the main supply, inverter unit shall continue to supply rated load from the battery bank for two hours duration.
- 4.11 Charger shall simultaneously supply entire power necessary for inverter and to keep the battery of required capacity in fully charged condition. Provision for automatic charging in both float and boost shall be made.
- 4.12 Battery shall be Nickel-Cadmium or Lead Acid Plate tubular positive plate or VRLA type. The battery capacity shall be decided considering load power factor as 0.8, derating factor for ageing 0.8 and derating for minimum ambient temperature as applicable.
- 4.13 The ventilation fans, if provided shall be fully redundant and connected to the output from the inverter and an audio-visual alarm shall be provided on its failure. It shall be possible to operate inverter for about half an hour even after the failure of the fan without temperature rise inside the inverter cubicle exceeding the safe operating temperature limits.
- 4.14 In case of inverter failure due to any reason or overload, affected unit shall be isolated and changeover to other inverter or to bypass shall take place automatically.
- 4.15 Noise level at a distance of 1m from UPS panels shall not exceed 60 dB.
- 4.16 UPS system shall be provided with necessary control, protection, metering, indication, alarm & annunciation for reliable and safe operation of the system. The suggestive list is indicated in Annexure-II.

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- 4.17 All semi-conducting devices shall be protected by fast acting semi-conducting fuses. These fuses shall be co-ordinated with load side HRC fuses.
- 4.18 The battery may be taken out of service for maintenance during which period it shall be possible for the inverter to continue operation taking power from the rectifier. The input filter of the inverter shall be suitably designed to take care of this operational requirement.
- 4.19 It shall be possible to vary the output voltage steplessly within $\pm 5\%$ of the specified output voltage. This adjustment shall be possible to be made when UPS is in operation.
- 4.20 UPS system shall be suitable for both floating output and earthing of one leg in case of single phase system / star-point in case of three phase system.
- 4.21 The UPS system shall have very high system of reliability having minimum MTBF of 50,000 hrs. Vendor shall furnish the value of MTBF, MTTR & availability factor.

5.0 CONSTRUCTIONAL DETAILS

- 5.1 The equipment shall preferably be supplied in enclosed, dust & vermin proof, floor mounted, sheet steel enclosure. In case, it is necessary to provide opening for ventilation, this should be closed by fine mesh. Minimum degree of protection for enclosure shall be IP-43 as per IS/IEC-60947.
- 5.2 Enclosure shall be fabricated with cold rolled sheet annealed steel of minimum thickness 2.0 mm.
- 5.3 The door hinges shall be concealed type. The doors and the removable covers shall be provided with non-deteriorating neoprene gaskets without any discontinuities. Gaskets shall be held in position in groove in shaped sheet steel work or these shall be of U type.
- 5.4 All external hardware shall be cadmium plated steel. Hardware for fixing the removable parts shall be provided with retaining devices.
- 5.5 Panels shall be liberally designed. All components shall be so mounted that they are easily accessible for inspection and maintenance.
- 5.6 UPS unit shall preferably have separate panels for each rectifier inverter units, bypass supply, distribution boards etc. Various panels of UPS except distribution boards shall be mounted side-by-side & bolted together to form compact assembly.
- 5.7 Distribution boards shall be of fixed type single front execution in fully compartmentalised design and divided into distinct panels each comprising of bus-bar chambers, individual feeder modules and vertical cable alley.
- 5.8 Mounting height of components requiring operation and observations shall not be lower than 300 mm and higher than 1800 mm.
- 5.9 All the live parts which are accessible after opening the front cover / back cover shall be properly insulated or provided with insulating barrier to prevent accidental contact. Bus bars of distribution boards shall be PVC sleeved.
- 5.10 Nameplate consisting of black Perspex with white engraving shall be provided for each panel and for each equipment mounted on the front of the panel. Suitable label identification for each component mounted inside the panel shall also be provided.
- 5.11 All the wirings shall be properly laid and ferruled at both ends. PVC channels may be used for wiring. For control wiring, minimum 1.5 sq. mm copper conductor shall be used.

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- 5.12 The power connections shall be made by PVC insulated flexible copper cables or taped copper / aluminium strip.
- 5.13 All power & control cables shall enter from the bottom.
- 5.14 Removable bolted aluminium gland plate, heavy duty compression type rolled aluminium cable glands, crimping type aluminium cable lugs for Al. cables and copper cable lugs for Cu. cables, pressure clamp / bolted type terminals etc. shall be provided for each incoming and outgoing cable.
- 5.15 Terminal blocks shall be grouped according to circuit functions and suitably numbered. 20% extra terminals shall be provided in the terminal block.
- 5.16 A suitably sized earth bus shall be provided at the bottom of panel with provision for earth connection at both ends to purchaser's earth grid.
- 5.17 All panels shall be of same height so as to form a bank which shall give good aesthetic appearance.

6.0 COMPONENT DETAILS

- 6.1 All components shall conform to relevant IS / IEC standards and shall be of reputed make. Makes of all components shall be subject to owner's / consultant's approval.

6.2 Thyristors, diodes and transistors

The thyristors, diodes and transistors shall have adequate safety margins to withstand specified operating conditions. A factor of safety of minimum 4 shall be taken against voltage surges.

6.3 PCBs

All electronic control & monitoring printed circuit cards shall preferably be modular plug in type. Monitoring points shall be provided in each of the PCB, PCBs shall be firmly clamped in position so that vibration or long usage does not result in loose contacts. Failure of each PCB shall be indicated by visual alarm and indication. The visual fault diagnostic shall preferably indicate fault into various sections of the card.

6.4 Transformers and Chokes

All transformers and chokes shall be of dry type and air cooled. This shall be class 'H' insulated, vacuum impregnated. Class B insulated cast resin transformers and chokes shall be also acceptable.

6.5 Electrolytic Capacitors

These shall be polarised aluminium type I, suitable for long life and category I, as per IS-4317 or equivalent IEC. The capacitor shall preferably be self healing type. These shall be so located in inverter panels that the operating temperature does not exceed 65°C maximum.

6.6 Instruments



Ammeters & voltmeters shall be moving coil type of class 1.5 accuracy as per IS-1248. These shall be flush mounting type of minimum size of 96 mm x 96 mm and shall have taut band scale of 240°. Frequency meter shall be of reed type having range of 45 Hz to 55 Hz.

6.7 Static Switches

Static switches shall be naturally commutated type with parallel inverse connected thyristors. These shall be rated for continuous duty for 100% load. Short time rated static switches are not acceptable.

6.8 Voltage Stabilizer

Voltage stabilizer shall be static type and shall satisfy the following requirements:

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- i) Maximum output voltage variation under steady state condition shall be $\pm 3\%$.
- ii) Maximum harmonic distortion shall be less than 5%.
- iii) The output voltage shall be restored within $\pm 2\%$ of nominal value in less than 2 secs.

6.9 **Battery**

Battery along with accessories shall conform to Engineering Standard ES-0814.

6.10 **Indication Lamps**

All indication lamps shall be of LED type suitable for the specified control voltage, having minimum illumination of 40 milli candela. The colour of the LEDs shall be as follows:

ON	:	Red
OFF	:	Green
FAULT	:	Yellow

6.11 **Moulded Case Circuit Breakers**

For isolating devices of various equipment, moulded case circuit breakers shall be used. These shall be provided with overload and short circuit protective devices and shall conform to IS 2516.

7.0 **OPTIONAL ITEMS**

These shall supplied as per requireemnt.

7.1.1 **Monitoring System** Microprocessor based monitoring system for UPS to supervise the UPS operation and to print out the following data at a preset time automatically by using its own printer shall be provided.



- i) Output voltage of UPS (Common)
- ii) Output current of UPS (Common)
- iii) Input DC voltage of each inverter
- iv) Input voltage of each rectifier (Ph to Ph)
- v) Input current of each rectifier
- vi) Output current of each inverter
- vii) Output voltage of each inverter
- viii) Room temperature
- ix) Input frequency of each inverter
- x) Output frequency of each inverter

7.1.2 In addition to print out once in a preset time, above data shall also be automatically printed for the following conditions:

- i) Power source change over from mains to battery and vice-versa.
- ii) Change over of load from UPS to bypass supply and vice versa.
- iii) On failure of UPS
- iv) On failure of either inverter
- v) Also facility for on demand print out of above data shall be provided.

7.1.3 On failure of UPS, the printer shall print out the waveform of the following:

- i) Output voltage of UPS

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- ii) Output current of UPS
- iii) Output voltage of each UPS
- iv) Output current of each UPS

7.2 **Insulation monitoring & automatic earth fault finding system**

Insulation monitoring and automatic earth fault finding system shall be provided to detect earth fault in unearthed system. The system shall preferably be of the type which injects a low frequency alternating voltage between the earth and the network which is used for determining the insulation resistance and to detect and locate earth faults. There shall be fixed detectors located in incoming feeders of main distribution boards and portable detector for location of fault within a feeder. The fixed detector shall be connected to a central unit which can display a faulty feeder.

7.3 Potential free contact shall be brought to outgoing terminal for remote monitoring system for the following:

- i) UPS-1 fault
- ii) UPS-2 fault
- iii) Load on inverter
- iv) Load on bypass

8.0 **PAINTING**

8.1 The enclosure after suitable pre-treatment shall be painted with two coats of anti-rust paint followed by two coats of anticorrosive paint.

8.2 All paints shall be carefully selected to withstand tropical heat and extremes of weather. The paint shall not scale off, crinkle or be removed by abrasion due to normal handling.



8.3 Unless otherwise specified, the finishing shade shall be light grey shade no.631 as per IS: 5.

8.4 Electrostatic powder paint shall be preferred.

9.0 **TESTS AND INSPECTION**

9.1 The UPS units shall be subjected to tests as per relevant standards. The tests shall include, but not limited to the following:-

- i) Rectifier & inverter soft starting
- ii) Regulation test
- iii) Heat run test for 8 hours
- iv) Overload test
- v) Test for changeover time in synchronised and desynchronised mode.
- vi) Test for dynamic response and transient performance
- vii) Sequence & transfer test
- viii) Noise level measurement
- ix) Test to check the selectivity of protective devices
- x) Alarm test (simulation of various fault conditions)
- xi) Measurement of harmonic distortion
- xii) Ventilation test (operation without fan)

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xiii) Insulation test

xiv) Current division in parallel UPS

9.2 All the above tests shall be carried out in presence of purchaser's representative. In addition, the equipment shall be subjected to stage inspection during process of manufacture at works and site inspection.

9.3 These inspections, shall, however, not absolve the vendor from his responsibility for making good any defects which may be noticed subsequently.

10.0 DRAWINGS AND DOCUMENTS

10.1 Drawings and documents as per Annexure-I shall be supplied, unless otherwise specified.

10.2 All drawings and documents shall have the following description written boldly.

- Name of client
- Name of consultant
- Enquiry / order number with plant / project name
- Equipment Code no. & Description

11.0 SPARES

11.1 Commissioning Spares : Commissioning spares, as required, shall be supplied with the main equipment. Item-wise list of recommended commissioning spares shall be furnished for information.

11.2 Spares for 2 Years Operation (Mandatory), as specified shall be supplied.

11.3 List of Recommend Spares (other than Mandatory Spares) alongwith recommended quantity shall be furnished.

11.4 All spare parts shall be identical to the parts used in the equipment

12.0 PACKING

12.1 The board shall be properly packed before despatch to avoid damage during transport, storage and handling.

12.2 The packing box shall contain a copy of the installation, operation and maintenance manual.

12.3 A sign to indicate the upright position of the panels to be placed during transport and storage shall be clearly marked. Also proper arrangement shall be provided to handle the equipment.

ANNEXURE - I



DOCUMENTATION FOR UNINTERRUPTED POWER SUPPLY

Sl. No.	Description	Documents Required (Y / N)		
		With Bid	For Approval	Final
1.	Specification sheet	N	Y	Y
2.	Technical Particulars	N	Y	Y
3.	Block Diagram	N	Y	Y
4.	General Arrangement drawings and foundation plan	N	Y	Y
5.	Calculation for battery sizing	N	N	N
6.	Feeder Details for Distribution Boards	N	Y	Y
7.	Descriptive literature and catalogues	N	N	Y
8.	Bill of materials	N	Y	Y
9.	Schematic & Wiring Diagram	N	Y	Y
10.	Installation, operation & maintenance manual	N	N	Y
11.	Spare parts list with identification	N	N	Y
12.	Test Certificates	N	N	Y
13.	Guarantee certificates	N	N	Y

Note:

1. 4 hard copies & 1 soft copy shall be supplied for approval after order within 4 weeks from the date of LOI.
2. 8 hard copies & 2 soft copies in CD shall be submitted as final documents prior to despatch of the equipment. These shall be made in sets and supplied in fine plastic coated folder.

Y - Yes, N – No

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ANNEXURE – II

METERING INDICATIONS AND ALARM SCHEDULE

A. METERING

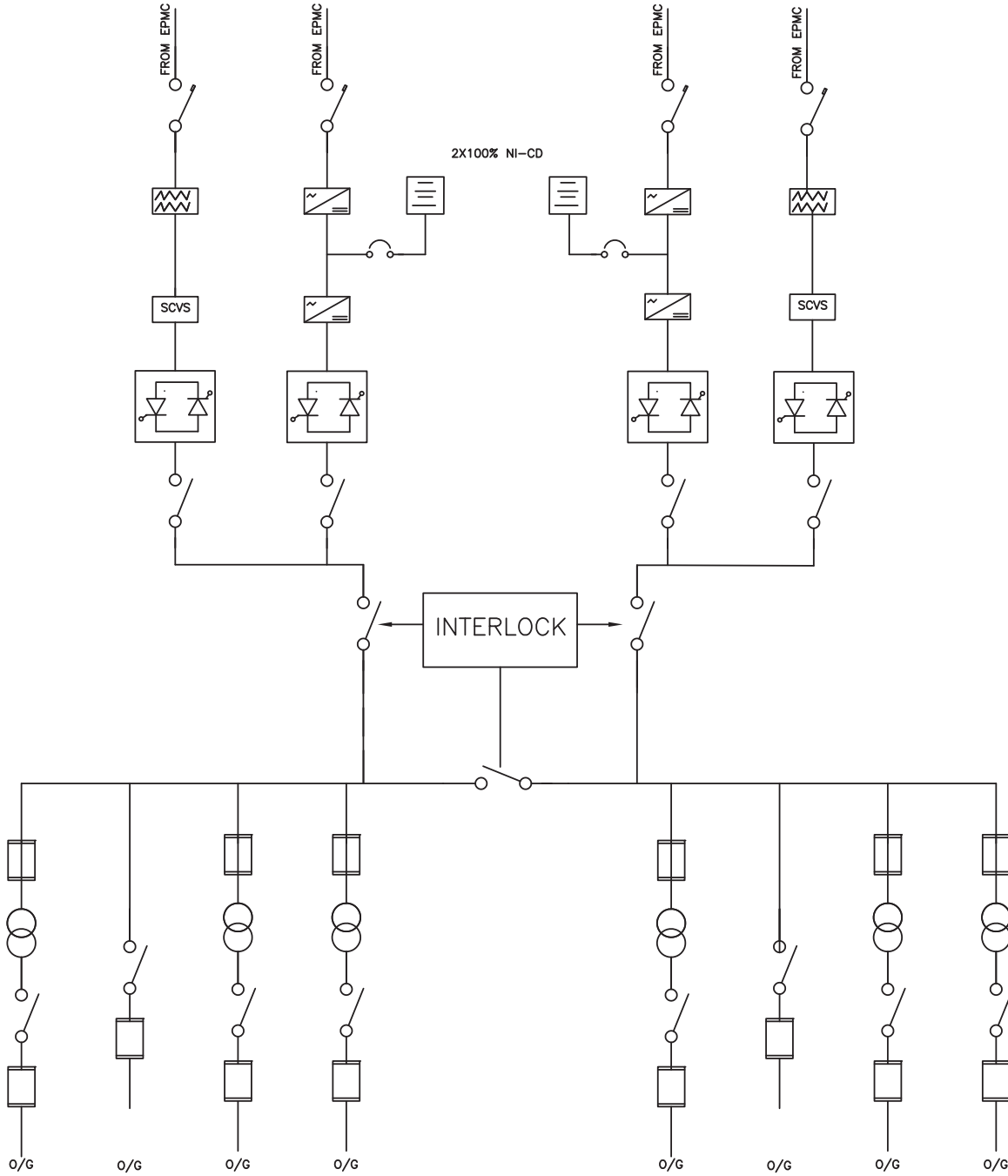
1. Incoming Voltmeter with selector switches for each incomer
2. Ammeter with selector switches for each incomer
3. Ammeter & Voltmeter at each inverter output and bypass output.
4. Frequency meter & power factor meter at one common point of output
5. Ammeter & Voltmeter at incoming of each UPS distribution boards
6. Ammeter at each rectifier output
7. Battery charge / discharge meter

B. LED INDICATION

1. A.C. Mains 'ON'
2. Rectifier output 'ON'
3. Load on inverter
4. Load on bypass
5. Inverter synchronised to mains
6. Battery on float
7. Battery on boost
8. Fault (one lamp for all types of fault)

C. AUDIO-VISUAL ALARM (with Accept, Reset & Test facilities)

1. Mains failure
2. Rectifier failure
3. Inverter output over voltage
4. Inverter output under voltage
5. Inverter fuse failure
6. Rectifier fuse failure
7. Fan failure
8. Inverter temperature high
9. Static switch failure
10. Bypass input failure
11. Inverter desynchronised



TYPICAL ACDB ARRANGEMENT
UPS SYSTEM

1ACDB SHALL HAVE TWO NO. INCOMER AND ONE NO. BUS COUPLER
2BATTERY CHARGER AND BATTERY FOR UPS SHALL BE AS PER JOB SPECIFICATION.

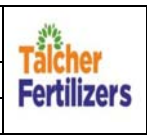
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TALCHER FERTILIZERS LIMITED
TECHNICAL SPECIFICATION – POWER TRANSFORMER

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TECHNICAL SPECIFICATION POWER TRANSFORMERS

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1.0 SCOPE

- 1.1 This standard covers the technical requirements of design, manufacture, testing at works and despatch in well-packed condition of Power Transformers.
- 1.2 This standard shall be applicable for 3 phase, core type, separate winding power transformers of rating 315 KVA and above.
- 1.3 This standard shall be read in conjunction with the relevant part of Design Philosophy – Electrical.

2.0 STANDARDS TO BE FOLLOWED

- 2.1 The design, manufacture and testing of the equipment covered by this standard shall comply with the latest issue of IS 2026, unless otherwise specified. Equipment complying with equivalent IEC standards shall also be acceptable.
- 2.2 The design and operational features of the equipment offered shall comply with the provisions of the latest issue of the Indian Electricity Rules and other relevant Statutory Acts and Regulations. The supplier shall, wherever necessary, make suitable modifications in the equipment to comply with the above.
- 2.3 Wherever any requirement, laid down in this standard, differs from that in Indian Standard Specifications, the requirement specified herein shall prevail.

3.0 SERVICE CONDITIONS

3.1 Ambient Conditions

These shall be as indicated in Design Philosophy – Electrical.

3.2 System Details

These shall be as indicated in Design Philosophy – Electrical.

4.0 OPERATING REQUIREMENTS


- 4.1 The transformer shall be suitable for operating at the rated capacity continuously at any of the taps, under the ambient conditions and with the voltage and frequency variations without exceeding the permissible temperature rise and without any detrimental effect on any part.
- 4.2 The transformer shall also be capable of delivering rated current at a voltage equal to 105 % of the rated voltage.
- 4.3 The maximum flux density in any part of the core and yoke at the rated MVA, voltage and frequency shall be such that under 10 per cent continuous over voltage condition it does not exceed 1.9 Tesla at any tap position.
- 4.4 The transformer shall be capable of allowing at least three consecutive starts of the largest Squirrel Cage Induction Motor, while delivering 85% of its rated power without any harmful effect on its insulation. It shall be possible to repeat the starting cycle once in eight hours.
- 4.5 The transformer shall be designed to be loaded as per IS 6600.
- 4.6 The transformer shall be so designed as to operate in parallel satisfactorily with similar transformers.

5.0 GENERAL DESIGN FEATURES

- 5.1 Transformers shall be built under strict quality assurance procedures to comply with IEC 60076 and or IEC 60726.
- 5.2 Transformers shall be suitable for continuous operation at full load for at least 30,000 hours without maintenance requiring the transformer to be de-energized
- 5.3 The design of the transformers shall be in accordance with the latest practice.

5.4 Rated Voltage, Frequency and Phase Connection

These shall be as indicated in Design Philosophy – Electrical.

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- 5.5 The transformer shall be so designed that it is capable of operation at 125% rated voltage for a period of one minute and 140% rated voltage for a period of five seconds due to sudden load throw off.
- 5.6 Transformer shall be capable of withstanding thermal and mechanical stresses caused by symmetrical or asymmetrical faults on any winding.
- 5.7 Transformers shall withstand, without injurious heating, combined voltage and frequency fluctuations which produce the following over fluxing conditions:
- 110% for continuous operation
 - 125% for 1 - minute
 - 140% for 5 – seconds
- 5.8 **Tap Changing Gear**
- 5.8.1 Each transformer shall be provided with on-load/ off-circuit tap changing equipment on the high voltage winding with taps. It shall be mounted on one side, in an easily accessible position.
- 5.8.2 The range of tap changer shall be as indicated and arranged in steps of 2.5%.
- 5.8.3 The off-circuit tap changing shall be affected by an externally operated handle capable of being padlocked in any position and provided with tap position indicator and mechanical stops at the extreme positions.
- 5.8.4 For transformer specified with on-load tap changer, tap changing gear shall be complete with tap position indicator, limit switch, lock and key and necessary control panel. Provision shall be made for auto-manual operation. The manual operation shall be possible both from the panel as well as from field. In case the tap changer is located in a separate housing, the housing shall be connected with the conservator for oil connection. A separate buchholz relay shall be provided in such a case. Emergency mechanical manual device shall also be provided. A minimum of 2 lakh trouble-free operations shall be considered.
- 5.9 **On-Load Tap-Changing Mechanism (O.L.T.C.)**
- 5.9.1 For transformer specified with on-load tap changer, high speed tap changing gear shall be complete with tap position indicator, limit switch, lock and key and necessary control panel. Provision shall be made for auto-manual operation. In case the tap changer is located in a separate housing, the housing shall be connected with the conservator for oil connection. A separate buchholz relay shall be provided in such a case. Emergency mechanical manual device shall also be provided. A minimum of 2 lakh trouble-free operations shall be considered. The OLTC gear shall have diverter resistance and the current diverting contacts shall be housed in a separate oil chamber segregated from the main tank of the transformer.
- 5.9.2 Transformer shall be provided with an on-load tap changing mechanism, as required. This shall be designed suitable for remote control operation from switch boards in the control room in addition to being capable of local manual as well as local electrical operation.
- 5.9.3 It shall not be possible to use the electric drive when manual gear is in use and it shall be possible to use only one electrical control at a time. Operation of the local or remote control switches shall cause one tap movement only until the control switch is returned to the off position for the next operation.
- 5.9.4 The local electrical control switches shall be mounted in the outdoor cubicle.
- 5.9.5 The equipment shall be so arranged as to ensure that when a tap change operation has been commenced it shall be completed independently of the operation of the control relays and switches. If a failure of the auxiliary supply during a tap change or any other contingency result in that movement not being completed, adequate means shall be provided to safeguard the transformer and its auxiliary equipment from damage. Supervisory indication shall be provided to indicate “The change incomplete” foul.

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- 5.9.6 Limit switches may be connected in the control circuit of the operation motor provided that a mechanical de-clutching mechanism is incorporated. Otherwise it shall be directly connected to the operating motor circuit and mechanical stop provided.
- 5.9.7 Thermal devices or other means shall be provided to protect the motor and control circuits. All relays switches, fuses etc. shall be mounted in the marshalling box and shall be clearly marked to indicate their purpose.
- 5.9.8 The whole of the apparatus shall be of robust design and capable of giving satisfactory service without undue maintenance under the conditions to be met in service, including frequent operation.
- 5.9.9 A five-digit counter shall be fitted to the tap changing mechanism to indicate the number of operations completed by the equipment.
- 5.9.10 A permanently legible lubrication chart shall be fitted within the driving mechanism chamber.
- 5.9.11 The On-Load Tap Changer shall include the following :-
- a) An oil immersed tap selector and arcing switch or arc-suppressing tap selector, provided with resistor for reduction of make and break arcing voltage, overload and short circuits.
 - b) Motor driven mechanism.
 - c) Control and Protection devices.
 - d) Local and remote tap-changer position indicator.
 - e) Manual operating device.
- 5.9.12 The on-load tap changer shall be designed so that the contacts shall not interrupt arc within the main tank of the transformer. The tap selector and arcing switch or arc suppressing tap selector switch shall be located in one oil filled compartment. The compartment shall be provided with a means of releasing the gas produced by the arcing. It shall be designed so as to prevent the oil in the tap selector compartment from mixing with the oil in the transformer tank.
- 5.9.13 The oil in those compartments of the main tap-changing apparatus which do not contain contacts used for making or breaking current shall be maintained under conservator head by means of an adequate diameter pipe corresponding dia of OLTC oil surge relays connection from the highest point of the chamber connection corresponding to the dia. of OLTC oil surge relay from the highest point of the chamber to the conservator. This connection shall be controlled by a suitable valve and shall be arranged so that any gas leaving the chamber will pass into the gas and oil actuated relay.
- 5.9.14 The tap changer shall be capable of permitting parallel operation with other transformers for which necessary wiring and accessories, if any, shall be provided.
- 5.9.15 The centre of manual operating device shall be located at a height of 1500 mm from rail top so that it can be operated by a person standing at the ground level. The arrangement shall be strong and robust in construction. The transformer shall give full load output on all tap positions.
- The mechanism shall be complete with normal accessories including at least the following:-
- A mechanical tap position indicator (Rated tap voltages shall be marked on the diagram plate).
 - A mechanical operation counter.
 - Mechanical stops to prevent over cranking of the mechanism beyond extreme tap positions.
- 5.9.16 The control scheme for the tap changer shall be provided for independent control of the tap changers when the transformers are in independent service. In addition, provision shall be made to enable parallel operation control also at time so that the tap changer will be operated simultaneously when one unit is in parallel with another will not become out of step and this will eliminate circulating current.

Additional features like Master / Follower and visual indication during the operation of motor shall also be incorporated.

Control circuit shall incorporate the following:

- a) Local/remote manual electrical operation.
- b) Device to ensure a positive and full completion of tap change once it is initiated even if there is loss of power.
- c) An interlock to cut-off electrical control automatically upon recourse being taken to manual mechanical control in emergency.
- d) Electrical interlock to cut-off a counter impulse for a reverse tap change, being initiated during a progressive tap change and until the mechanism comes to rest and resets circuits for a fresh operation.
- e) All auxiliaries and devices for electrical control of OLTC gear should be housed in a weather-proof cabinet mounted on the transformer and shall include:
 - Local tap position indicator
 - 5 digit operation counter
 - Cubicle lighting
 - Thermostatically controlled space heater.
 - Miniature circuit breaker with magnetic and thermal overload devices for controlling the incoming supply to the OLTC motor.
 - Padlocking arrangement for the hinged cabinet door.
 - Removable plate with cable glands.
 - Inside tag with control scheme indelibly marked.


5.9.17 Necessary interlock, blocking independent control when the units are in parallel, shall be provided.

5.9.18 Under abnormal conditions such as may occur if the contactor controlling one tap changer sticks, the arrangement must be such as to switch off supply to the motor so that an out of step condition is limited to one tap difference between the units. Details of out of step protection provided for the taps should be furnished in the bid.

5.9.19 The contactor and associated gear for the tap change driving motors shall be housed in a local kiosk mounted adjacent to the transformer. The motors shall be suitable for operation on 230 V single phase or 3-phase 440 V, 50 cycle external power supply. The kiosk having space heater, shall be dust and vermin proof and suitable protected against corrosion or deterioration due to condensation, fungi etc.

5.9.20 Indoor cubicle (RTCC panel) shall be provided in the control room which shall contain :

- a) Indication of the transformer ratio in use on each transformer and the number designating the tap in use by means of digital type indicators.
- b) Raise and lower push Button switch and AVR Relay.
- c) Independent/Master/Follower selector switch.
- d) Remote tap position indicator with indicating lamp.
- e) Repeater dial of winding temperature indicator for remote indication with a device for indicating hottest spot winding temperature in addition to a pointer to register the highest temperature reached.
- f) An indication lamp showing tap change in progress.
- g) Necessary audible and visual alarms.
- h) Pressure relief device operation alarm.

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- i) Out of step relay with two spare contacts (2 NC and 2 NO).
- j) The remote indoor cubicle in addition to the above indications shall also have the following trip and non-trip alarm windows facias with 5 spare windows suitable for 110V DC supply.
 - i. Oil Temperature alarm
 - ii. Winding Temperature alarm
 - iii. Winding temperature trip
 - iv. Buchholz alarm
 - v. Buchholz trip
 - vi. Sudden Pressure trip (Main tank)
 - vii. Surge Relay trip (OLTC Gear)
 - viii. Tap changer out of step alarm
 - ix. Low oil level alarm
 - x. Cooling fans working indication
 - xi. Oil pumps on and off indication
 - xii. Failure of group of fans alarm
 - xiii. Failure of group of oil pumps alarm
 - xiv. Failure of supply
 - xv. Oil flow alarm

Each relay for tripping function shall have two normally open and two normally closed contacts for connection.

5.9.21 Remote Electrical Group Control

The OLTC control scheme offered shall have provision of remote electrical group control during the parallel operation of transformer. This is in addition to independent control of OLTC:

- i) 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 Master, Follower or Independent mode.

- ii) 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.
- iii) **Master Position**

If the selector switch is in Master position, it shall be possible to control the OLTC units in the follower mode by operating the controls of the master unit. Independent operation of the units under Follower mode shall have to be prevented. However the units under independent mode will be controlled independently.

- iv) **Follower Position**



If the selector switch is in Follower mode, control of OLTC shall be possible only from panel of the Master unit.

- v) **Independent Position**

In this position of Selector Switch, Control of OLTC of individual unit shall only be possible

5.9.22 The OLTC shall be provided on the conservator side of the Power Transformer and not in front of H.V. Bushings.

5.9.23 OLTC shall be suitable for bi-directional power flow.

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5.10 Impedance Voltage

The impedance voltage of the transformer at 75OC shall be as per latest IS 1180. This shall be guaranteed within limits specified in relevant IS / IEC at principal tap position. There shall not be any negative tolerance.

5.11 Losses

The losses at 50 percent of rated load and full load condition, at the rated voltage and frequency shall be indicated by the vendor at 75OC. These shall be guaranteed within the tolerable limits specified in IS:2026 at principal tap position. Owner has the right to impose penalty charges or reject the transformer in case of any difference in the test and guaranteed values.

For upto 2 MVA transformer losses shall be as per energy efficiency level-3 of latest IS 1180.

5.12 Temperature Rise

The temperature rise of the winding, oil and core shall not exceed the values specified in IS: 2026 when the transformer is delivering its rated output continuously under the service conditions.

5.13 Insulation Level

All windings up to maximum system voltage of 72 KV shall have uniform insulation to earth. For windings having higher maximum system voltage, graded insulation is acceptable.

5.14 Terminal Arrangements

The HV and LV side terminal arrangement shall be provided as required. Disconnecting link chambers shall be provided on the transformer primary side in all cases as well as on secondary side, except where the termination is through bus duct. The disconnecting chambers shall be oil filled, preferably connected with the main tank through an isolating valve and also provided with a drain valve. However for system not exceeding 11 KV, air filled disconnecting chamber may be accepted. Suitable cable end box complete with cable glands and lugs shall be provided for termination of cables. Gland plate for single core cables shall be non-magnetic.

5.15 The transformer shall be able to withstand the electro-dynamic and thermal stresses due to terminal short circuit of the secondary, assuming the primary side fed from an infinite bus. All leads and windings in cores shall be properly supported, clamped and tightened after vacuum drying to ensure the short circuit withstand capacity. The short circuit withstand duration shall be 3 Secs.

5.16 The short circuit test results for similar transformers shall be furnished.

5.17 The transformer shall be so designed as to minimise any undue noise and vibration.

The noise level shall be limited to the value specified by latest NEMA Standard / CBIP.

5.18 Due attention shall be given in the design for the suppression of harmonics.

5.19 Cooling System



5.19.1 The cooling system shall be provided as required. In case the transformer is designed for two types of cooling, the output rating for each type shall be indicated in the offer. The minimum acceptable output shall be 70% of rated output when forced type of cooling system is not in operation.

5.19.2 Wherever ONAF Cooling is specified, the cooling fans shall be adequately rated and shall be suitable for auto/manual and local/remote operation. Auto operation shall be through winding temperature indicator contact..

5.19.3 Transformer shall have multiple cooling units with standby cooling units.

5.19.4 Cooling fans for each radiator bank shall be housed in fan box to prevent ingress of rain water. Each fan shall be suitably protected by galvanized wire mesh guard. It shall be possible to remove the cooling fan with motors without disturbing and dismantling the cooler structural frame work.

5.19.5 Where OFAF cooling is applicable, two numbers of centrifugal oil pumps shall be used. Measures shall be taken to prevent mal-operation of Buchholz relay or sudden pressure relay

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when all oil pumps are simultaneously put into service. The pumps shall be so designed that on failure of power supply to the pump motor, the pump impeller will not limit the natural circulation of oil.

- 5.19.6 Cooling fans and oil pump motors shall be of squirrel cage, totally enclosed whether proof type suitable for operation on 400 volts, three phase, 50 Hz power supply. All motors having ball and roller bearings and grease lubricators shall be fitted with hexagonal nipples conforming to relevant Indian Standard.
- 5.19.7 An oil flow indicator with alarm contacts shall be provided for the confirmation of the oil pump operating in a normal state. An indication shall be provided on the control panel to indicate that the pump is running.
- 5.19.8 The coolers and theirs accessories shall be hot dip galvanized or corrosive resistant painted.
- 5.19.9 The supporting arrangement for the cooler units or for radiator banks shall be in such a manner that the stresses if developed, shall not be transferred to the flanges of the butterfly valves.
- 5.19.10 The shut off valves shall be provided on the tank at each point of connection of cooler units radiators to the transformer tank. Removable blanking plates shall be provided to permit blanking off the oil connection to cooler radiators.
- 5.19.11 All valves shall be of gun metal or cast steel or may have cast iron bodies with gun metal fittings. They shall be of full way type with internal screw and shall be opened by turning counter clock-wise when facing the hand wheel.
- 5.19.12 Means shall be provided for pad locking of valves in the open and closed position.
- 5.19.13 Every valve shall be provided with indicator to show clearly the position of the valve whether open or closed.
- 5.19.14 All valves shall be provided with flanges having machined faces.
- 5.19.15 The drilling of valve flanges shall comply with the requirements of IS:3639.

5.20 CONTROL OF COOLER OPERATION

- 5.20.1 Each motor or group of motors shall be provided with an electrically operated contactor and with control gear of suitable design both for starting and stopping the motor manually and also automatically from the contacts on the winding temperature indicating device as specified. Additional terminal for remote manual electrical control of motors shall be provided. Overload and single phasing protection shall be provided. HRC fuses shall be provided for short circuit protection. This equipment shall be accommodated in the marshalling box. The power supply shall be adequately and properly fused.
- 5.20.2 Where small motors are connected in groups, the group protection shall be arranged so that it operates satisfactorily in the event of a fault occurring on a single motor.
- 5.20.3 Where fans and oil pumps are provided, the connection shall be arranged as to allow the motors or groups of motors to be started up and shutdown either collectively or individually.
- 5.20.4 All motor contactors and their associated apparatus shall be capable of holding in and operating satisfactorily and without over heating for a period of ten minutes if the supply voltage falls for that period, to 75% of normal value and at normal frequency. The motor contactors and associated apparatus shall be capable of normal operation with a supply voltage of 85 % of the normal value and at normal frequency.
- 5.20.5 All contacts and other parts which may require renewal, adjustment or inspection shall be readily accessible.
- 5.20.6 The control arrangements are to be so designed as to prevent the simultaneous starting of motors of total rating of more than 20 HP where such an eventually may arise, two step operation shall be preferred.
- 5.20.7 Alarm indication for failure of group of fans and oil pump shall be provided.
- 5.20.8 Alarm indication shall be provided to indicate failure of power supply.



5.20.9 Provision in the cooler control circuit may be made such that tripping of transformer breaker on Differential or Sudden Pressure should lead to supply disconnection to motor of the cooler pump.

6.0 CONSTRUCTIONAL FEATURES

6.1 Core

6.1.1 The transformer core shall be of high grade, non-ageing, electrical silicon cold rolled magnetic sheet steel of low hysteresis loss and high permeability. The maximum flux density in any part of the core and yoke at rated voltage and frequency shall not exceed 1.7 Tesla. The core structure shall be securely grounded to prevent electrostatic potential. Lifting eyes and lugs shall be provided on the limbs and coils assembly. Preferably no bolt shall be used in the cores. Clamping shall be done external to the limb. Bolts passing through the yoke, if any, shall be insulated for 2 KV for transformers rated up to 33 KV and 5 KV for higher voltage ratings (rms) for 1 minute.

6.1.2 The temperature of the core shall not exceed that permitted in IS.

6.1.3 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 temperature of any part of the core or its support structure in contact with oil shall not exceed 120 deg C under normal operating condition and 130 deg C under most extreme operating condition. Adequate temperature margin shall be provided to maintain longer life expectancy for this material.

6.1.4 Core and winding shall be capable of withstanding the shock during transport, installation and service. Adequate provision shall be made to prevent movement of core and winding relative to tank during these conditions.

6.1.5 All steel sections used for supporting the core shall be thoroughly sand blasted after cutting, drilling and welding.

6.1.6 Each core lamination shall be insulated with a material that will not deteriorate due to pressure and hot oil.

6.1.7 The supporting frame work of the core shall be so designed as to avoid presence of pockets which would prevent complete emptying of tank through drain valve or cause trapping of air during oil filling.

6.1.8 Adequate lifting lugs will be provided to enable the core and windings to be lifted.

6.1.9 The core shall be earthed to the core clamping structure at one point only, through a removable external link suitably located and protected to facilitate testing after installation of the transformer.



6.1.10 In case core laminations are divided into sections by insulating barriers or cooling ducts parallel to the plane of the lamination, tinned copper bridging strips shall be inserted to maintain electrical continuity between sections.

6.1.11 A drawing furnishing the details of the internal earthing design shall be included in the manual

6.2 Tank

6.2.1 The tank shall be made of good commercial grade low carbon steel plate of adequate thickness capable of withstanding stress not less than 0.40 kg/cm², properly welded and gusseted to ensure a rigid construction. It shall also be able to withstand normal transportation shocks without any deformation and shall be capable of withstanding following vacuum.

Highest System Voltage	MVA Rating	Vacuum in mm of Hg
Up to 72 KV	Up to 1.6	250
	Above 1.6 to 20	500
	Above 20	760



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Above 72 KV

For all Ratings

760

- 6.2.2 For outdoor transformer, the top of the tank, the marshalling box and the headers of radiators, shall be of such a construction so as to prevent accumulation of water.
- 6.2.3 Guides shall be provided to facilitate tanking and untanking of the core with the coil assembly. The details of anchoring of core and coil assembly of the tank shall be furnished.
- 6.2.4 Radiators, where necessary, shall be provided on the tank to facilitate cooling. These shall be detachable type and shall be provided with isolating valves at ends, drain plug and air release plug. The radiators shall be fabricated out of minimum 1.25 mm thick seamless steel tubing or pressed sheet steel. For sizes up to 500 KVA, cooling tubes shall be acceptable.
- 6.2.5 Each tank shall be provided with:
- a) Lifting lugs suitable for lifting the equipment complete with oil.
 - b) A minimum of four jacking pads in accessible position to enable the transformer complete with oil to be raised or lowered using hydraulic jacks. Each jacking pad shall be designed to support with an adequate factor of safety for at least half of the total mass of the transformer filled with oil allowing in addition for maximum possible misalignment of the jacking force to the centre of the working surface.
 - c) Suitable haulage holes shall be provided.
- 6.2.6 The tank shall be designed in such a way that it can be mounted on the rollers.
- 6.2.7 The base of each tank shall be so designed that it shall be possible to move the complete transformer unit by skidding in any direction without injury when using plates or rails.
- 6.2.8 All bolted connections shall be fitted with weather proof, hot oil resistant, resilient gasket in between for complete oil tightness. If gasket is compressible, metallic stops/other suitable means shall be provided to prevent over-compression. All gasketed joints shall be designed, manufactured and assembled to ensure long-term leak and maintenance free operation. Groove provided to accommodate round nitrile rubber cord for rectangular openings shall be milled.
- 6.2.9 The transformer shall be mounted on rollers, as per manufacturer's standard practice.
- 6.2.10 The roller mounted transformers are to be provided with flanged bi-directional wheels and axles. This set of wheels and axles shall be suitable for fixing to the under carriage of transformer to facilitate its movement on rail track. Suitable locking arrangement along with foundation bolts shall be provided for the wheels to prevent accidental movement of transformer.
- 6.2.11 The rail track gauge shall be 1676 mm.
- 6.2.12 To prevent transformer movement during earthquake, suitable clamping devices shall be provided for fixing the transformer to the foundation.
- 6.2.13 The tank cover shall be designed to prevent retention of rain water and shall not distort when lifted. The internal surface of the top cover shall be shaped to ensure efficient collection and direction of free gas to the buchholz relay.
- 6.2.14 At least one adequately sized inspection openings shall be provided in the transformers for easy access to bushings and earth connections. The inspection covers shall not weigh more than 25 kg. Handles shall be provided on the inspection cover to facilitate lifting.
- 6.2.15 The tank covers shall be fitted with pockets at the position of maximum oil temperature at maximum continuous rating for bulbs of oil and winding temperature indicators. It shall be possible to remove these bulbs without lowering the oil in the tank. The thermometer shall be fitted with a captive screw to prevent the ingress of water.
- 6.2.16 Bushing turrets, covers of inspection openings, thermometer pockets etc. shall be designed to prevent ingress of water into or leakage of oil from the tank.

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6.2.17 All bolted connections shall be fitted with weather proof, hot oil resistant, resilient gasket in between for complete oil tightness. If gasket is compressible, metallic stops/other suitable means shall be provided to prevent over-compression. All gasketed joints shall be designed, manufactured and assembled to ensure long-term leak and maintenance free operation. Groove provided to accommodate round nitrile rubber cord for rectangular openings shall be milled.

6.2.18 The maximum temperature on any metal part shall not exceed 130 deg. Celsius.

6.2.19 Seamless pipe shall be used upto 80mm conforming to IS 1978 & IS 1979, ERW mild steels pipes as per IS 1239 (Part 1) medium shall be used for ≥ 100 mm and IS 3589 for 150mm. Non-magnetic Stainless-steel materials used shall conform to IS 6911 or ISO 683-13 or EN 10088-2 or AISI 304L or ASTM A240 or J4(S20430 Modified).

6.3 Windings

6.3.1 Each coil shall be made out of paper insulated electrolytic grade copper conductor. Similar coils shall be interchangeable. Successive coils of a winding shall be connected by accessible joints and shall be brazed and finished smooth to prevent abrasive damage to insulation. There shall be no sharp bends in the connecting leads to prevent corona discharge. Aluminium foil wound transformer will also be acceptable.

6.3.2 Immediately after winding process, it shall be vacuum dried, dimensionally pre-stabilized and oil impregnated before next process.. The insulation resistance and polarization index of the winding measured after impregnation shall be furnished in the test certificate.

6.3.3 The magnitude of impulse surges transferred from HV to the LV winding by inductive and capacitive coupling shall be limited to a value below the rated impulse strength of the LV winding. The impulse voltage test results and surge distribution on windings for similar transformer shall be furnished.

6.3.4 The manufacture shall ensure that windings are made in dust proof, Positive pressure, Desert Climate environment. Movement of windings and active part shall be done on air-casters to prevent shocks and abnormal jerks.

6.3.5 Winding clamping arrangement shall distribute the clamping forces evenly over the ends of the windings. All insulating materials and structures shall be protected from contamination and the effects of humidity during and after fabrication, and after receipt, by storing them in a separate, climate-controlled area.

6.4 Insulating Oil

6.4.1 The insulating oil shall be virgin high grade inhibited, conforming to IEC-60296 & all parameters specified below, while tested at supplier's premises. The contractor shall furnish test certificates from the supplier against the acceptance norms as mentioned below, prior to dispatch of oil from refinery to site. Under no circumstances, poor quality oil shall be filled into the transformer and only thereafter be brought up to the specified parameter by circulation within the transformer.

6.4.2 At manufacturer's works the quality of oil used for first filling, testing and impregnation of active parts shall meet at least parameters as mentioned in IEC . The oil test results shall form part of equipment test report.

6.4.3 Prior to filling in main tank at site and shall be tested for

1. Break Down voltage (BDV) : 70kV (min.)
2. Moisture content : 5 ppm (max.)
3. Tan-delta at 90 °C : 0.0025 (max)
4. Interfacial tension : More than 0.004 N/m

6.4.4 Prior to energisation at site oil shall be tested for following properties & acceptance norms as per below generally in line with IEC 60422:

1. Break Down voltage (BDV) : 70 kV (min.)



2. Moisture content : 10 ppm (max.)
3. Tan-delta at 90 °C : 0.01 (max.)
4. Resistivity at 90 °C : 6×10^{12} ohm-cm (min.)
5. Interfacial tension : 0.035 N/m (min.)
6. *Oxidation Stability (Test method as per IEC 61125 method C, Test duration: 500hour for inhibited oil)
 - a) Acidity: 0.3 (mg KOH /g) (max.)
 - b) Sludge: 0.05 % (max.)
 - c) Tan delta at 90 °C: 0.05 (max.)
7. * Total PCB content : Not detectable (2 mg/kg total)

* For Sr. No. 6 & 7 separate oil sample shall be taken and test results shall be submitted within 45 days after commissioning for approval of Consultant.

Oil sample shall be drawn before and after heat run test and shall be tested for dissolved gas analysis. Oil sampling to be done 2 hours prior to commencement of temperature rise test. For ONAN/ONAF cooled transformers, sample shall not be taken earlier than 2 hours after shutdown. The acceptance norms with reference to various gas generation rates shall be as per IEC 61181.

6.5 Insulation Materials



- 6.5.1 Class 'A' insulating materials specified in IS 1271 shall be used. Paper insulation shall be new and free from punctures. Wood insulation, where used, shall be well seasoned and treated.
- 6.5.2 The mineral oil shall comply with IS: 335. 10% extra oil shall be supplied along with the transformer in non-returnable drums.
- 6.5.3 For the transformers required to be filled up with inert gas for transport purpose, the required amount of oil including 10% extra shall be supplied in non-returnable drums.

6.6 Bushing

- 6.6.1 The bushing insulator shall be rated for the maximum system voltage and shall comply with the requirements laid down in IS. The minimum current rating shall be 400 Amps. in case of overhead line connected transformers, the bushings shall be outdoor type having creepage distances of 31mm/kV and complete with arcing horns. In case of transformers connected with bus duct or cable, the bushings shall be enclosed in the terminal box. In either case, they shall be detachable from outside of the tank. The hardware shall be of tinned copper or nickel plated brass suitable to receive the conductors. Separate neutral bushings shall be provided for earthing the neutral, as required. All bushings shall be marked with the symbols corresponding to the connection diagram indicated in the diagram plate and in accordance with IS.
- 6.6.2 Bushing rated 52 KV class and above shall be oil impregnated paper condenser bushings. Bushing rated below 52KV voltage class shall be solid porcelain or oil communicating type.

6.7 Conservator

- 6.7.1 Main conservator shall have air cell type constant oil pressure system to prevent oxidation and contamination of oil due to contact with moisture, and shall be fitted with magnetic oil level gauge with low oil level potential free contacts.
- 6.7.2 OLTC shall have conventional type conservator with prismatic oil level gauge.
- 6.7.3 Conservator tank shall have adequate capacity with highest and lowest visible-levels to meet the requirements of expansion of total cold oil volume in the transformer and cooling equipment from minimum ambient temperature to 100degC. The capacity of the conservator tank shall be such that the transformer shall be able to carry the specified overload without overflowing of oil. The Calculation shall be submitted during design review.

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- 6.7.4 The conservator shall be fitted with integral lifting lugs in such a position so that it can be removed for cleaning purposes. Suitable provision shall be kept to replace air cell and cleaning of the conservator wherever applicable.
- 6.7.5 Conservator shall be positioned so as not to obstruct any electrical connection to transformer. Pipe work shall neither obstruct the removal of tap changers for maintenance or the opening of inspection or manhole covers.
- 6.7.6 Pipe work connections shall be of adequate size for their duty and as short and direct as possible. Only radiused elbows shall be used.
- 6.7.7 The feed pipe to the transformer tank shall enter the transformer cover plate at its highest point and shall be straight for a distance not less than five times its internal diameter on the transformer side of the Buchholz relay, and straight for not less than three times that diameter on the conservator side of the relay.
- 6.7.8 This pipe shall rise towards the oil conservator, through the Buchholz relay, at an angle of not less than 5 degree.
- 6.7.9 Contact of the oil with atmosphere is prohibited by using a flexible air cell of nitrile rubber reinforced with nylon cloth.
- 6.7.10 The temperature of oil is likely to rise upto 100 deg C during operation. As such air cell used shall be suitable for operating continuously at 100 deg C.
- 6.7.11 Air cell of conservator shall be able to withstand the vacuum during installation /maintenance periods. Otherwise provision shall be kept to isolate the conservator from the main tank when the latter is under vacuum by providing a vacuum sealing valve or other suitable means in the pipe connecting main tank with the conservator.
- 6.7.12 The transformer manual shall give full and clear instructions on the operation, maintenance, testing and replacement of the air cell. It shall also indicate shelf life, life expectancy in operation, the recommended replacement intervals and the supplier.
- 6.7.13 The connection of air cell to the top of the conservator is by air proof seal preventing entrance of air into the conservator.

6.8 **Neutral Earthing Arrangement**

The neutral terminals of transformer shall be brought to the ground level by a brass/tinned copper grounding bar, supported from the tank by using porcelain insulators. The end of the brass/tinned copper bar shall be brought to the bottom of the tank, at a convenient point, for making bolted connection to two (2) 75 x 6 mm galvanised steel flats connected to Owner's grounding mat.

7.0 **FITTINGS**

- 7.1 Fittings as listed in Annexure - I shall be provided. Any other fittings which may be necessary for the satisfactory operation of the transformer shall also be provided on each transformer.
- 7.2 All fittings shall conform to relevant Indian Standard Specifications.
- 7.3 Fittings such as conservator and associated pipes, explosion vent pipe etc. shall be designed to withstand vacuum as specified in Clause 6.2.1 against atmospheric pressure.
- 7.4 Fittings such as rating plate, dehydrating breather, off-circuit tapping switch, dial type thermometer etc. which need to be observed/ operated, shall be mounted at convenient heights of not more than 1.5 M from the base of the transformer and located so as to be clearly visible from the front.
- 7.5 All opening shall be provided with gasketed metallic covers for protection during transportation.
- 7.6 All valves shall be of globe/butterfly type provided with blanking plates. The valve body shall be made of either Carbon Steel with trim of 13 Cr. steel or gun metal.

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- 7.7 The rating plate, the terminal diagram and terminal marking plates shall be made of Aluminium and shall contain relevant details as per IS 2026. The Code No. of equipment shall be marked on a separate plate.
- 7.8 All terminals shall be anti loosening type and complete with connectors of required size. The earthing terminals shall have identification marks.
- 7.9 All valves in oil line shall be suitable for continuous operation with transformer oil at 115 deg C.
- 7.10 The oil sampling point for main tank shall have two identical valves to be put in series .Oil sampling valve shall have provision to fix rubber hose of 10 mm size to facilitate oil sampling.
- 7.11 A valve or other suitable means shall be provided to fix (in future) on line dissolved gas monitoring system to facilitate continuous dissolved gas analysis. The location & size of the same shall be finalised during detail engineering stage

7.12 Winding Temperature Indicator

Winding temperature indicator for measuring hot spot temperature of the winding shall comprise of current transformer image coil, temperature sensing element, capillary tube jacketed with PVC sleeve, 150 mm dia. local indicating instrument with two pairs of contacts one for alarm and other for trip and maximum point indicator capable of being reset by hand without tools.

In addition to the above, the following equipment shall be provided for remote indication of winding temperature for each of the winding:

a) Signal transmitter for each winding

Signal transmitter shall have additional facility to transmit signal for recording winding temperature at Owner's data acquisition system, for which duplex platinum RTD with nominal resistance of 100 ohms at zero degree centigrade shall be supplied. The RTD shall be three wire ungrounded system. The calibration shall be as per SAMA (USA) standard or equivalent. The RTD may be placed in the pocket containing temperature sensing element and image coil for WTI system which will be used for both remote WTI and DAS. Necessary equipment for sending the signal to remote WTI and DAS shall be provided. In lieu, separate RTD for each of the functions shall be provided.

b) Remote winding temperature indicator

It shall be suitable for flush mounting on Owner's panel. This shall not be repeater dial of local WTI and will operate by signal transmitter. Any special cable required for shielding purpose, for connection between cooler control cabinet and remote WTI control circuit, shall be in the scope of Contractor. Only one RWTI with a selector switch shall be provided for all the windings (HV and LV).



7.13 Oil Temperature Indicator

Oil temperature indicator for measuring top oil temperature shall comprise of 150 mm dial type thermometer, thermometer pocket and capillary tube jacketed with PVC sleeve. Thermometer shall have two pairs of contacts, one for alarm and other for trip and maximum point indicator capable of being reset by hand without tools.

In addition to the above, the following equipment shall be provided for remote indication of oil temperature:

a) Signal transmitter

Signal transmitter shall have additional facility to transmit signal for recording oil temperature at Owner's data acquisition system, for which duplex platinum RTD with nominal resistance of 100 ohms at zero degree centigrade shall be supplied. The RTD shall be three wire ungrounded system. The calibration shall be as per SAMA (USA) standard or equivalent. The RTD may be placed in the pocket containing temperature sensing element and image coil for OTI system which will be used for both remote OTI and DAS. Necessary equipment for sending the signal to remote OTI and DAS shall be provided. In lieu, separate RTD for each of the functions shall be provided.

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b) Remote oil temperature indicator

It shall be suitable for flush mounting on Employer's/RTCC panel. This shall not be repeater dial of local OTI and will operate by signal transmitter. Any special cable required for shielding purpose, for connection between cooler control cabinet and remote OTI control circuit, shall be in the scope of Contractor. Only one ROTI with a four point selector switch shall be provided.

7.14 Buchholz Relay

The Buchholz relay as per IS 3637 shall be of double float type, provided with, two pairs of contacts, one for alarm and other for trip, facility for testing by injection of air by hand pump and with a cock for draining and venting of air. The relay shall be provided with shutoff valves on the conservator side as well as on the tank side.

The alarm and trip contacts of all protective devices shall be potential free and rated for 1 Amp at 110 V / 220 V D.C.

7.15 Marshalling Box

A marshalling box shall be provided to accommodate all auxiliary devices except those which are to be located directly on transformer or housed in a separate panel.

- i. Terminal boxes, Junction Boxes & Marshalling Panel shall have IP 55 enclosure(min.), dust, weather and vermin proof type.
- ii. The marshalling box shall be dust, weather and vermin proof type made of sheet steel of not less than 2 mm thick. The box shall be rectangular in shape having sufficient space for easy termination of cables. The terminal block shall be pressure clamp type. 10% spare terminals shall be provided.

Suitable heavy duty double compression type rolled Aluminium cable glands for all incoming and outgoing cables shall be provided.

7.16 Current Transformers

The current transformers shall be provided and shall comply with IS 2705. The C.T. terminals shall be accessible through a weatherproof removable cover for the purpose of testing etc. CT polarity shall be clearly marked. The C.T. for standby earth fault protection shall be 15 VA, 5P10. The C.T's for differential and restricted earth fault protection shall be of Class PS accuracy. The values of V_k and I_{mag} for these CTs shall be furnished at the order stage.

7.17 Wiring

All controls, indication and protective devices provided on the transformer shall be wired upto the terminal block inside the marshalling box, by means of stranded copper heat resistant PVC insulated armoured cable of 1.1 KV grade and size not less than 2.5 sq. mm. Wiring shall be properly fixed on cable tray with at least 100 mm clearance from the transformer body. Suitable identification mark shall be provided on all wires.



7.18 All bought out items shall be of reputed make to be approved by Consultant/ Owner.

7.19 NITROGEN INJECTION FIRE PREVENTION AND EXTINGUISHING SYSTEM

7.19.1 Nitrogen Injection Fire Prevention and Extinguishing System shall be provided for fire protection of Transformer against fire due to an arc, during internal faults and external fires is for preventing tank explosion. The system design shall also conform to TAC/ NFPA norms.

7.19.2 The system should comprise the following :-

- i. Fire Extinguishing Cubicle with base frame and containing, oil drain assembly, nitrogen cylinder, electric mechanical control unit for oil drain and nitrogen release detections necessary for monitoring system flanges on top panel for connecting pipe connections from transformer, panel lighting etc.
- ii. Control Box for monitoring system operation, automatic control and remote operation, with alarms, indication light switches, push buttons, audio signal, suitable for tripping and signaling on 110V DC supply.

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- iii. Pre-stressed non-return valve (PNRV) working on transformer oil flow rate, with proximity switch for remote alarm indication and with visual position indicator.
- iv. Required number of fire detectors rated for 141⁰C for heat sensing, each fitted with two number cable glands.
- v. Signal box for terminating cable connections from PNRV and fire detectors.
- vi. Pressure relief valve with limit switch.

7.19.3 The following arrangements are required to be made on the transformer Tank at the time of fabrication of the tank :-

- i. Oil drain opening with pipe, flange and manual gate valve at about 120mm below the top cover. Pipe size DN125 for 100 MVA and higher ratings.
- ii. Nitrogen Injection openings with pipe size DN 25 with flange and manual gate valve on tank sides at about 100-200 mm from the bottom plate.
- iii. Flanges having 4 Nos. 18 dia. holes with pcd as 155mm and dummy pipe on the conservator pipe between buchholz relay and conservator tank manual gate valve, for fixing PNRV.
- iv. Fire detector brackets on top cover.
- v. Brackets for fixing signal box at a suitable location on top cover or tank size wall.

7.19.4 **ACTIVATION OF NIFPES:**

Mal-functioning of fire prevention / extinguishing systems is their major shortcoming which leads to interruption in power supply. The Contractor shall ensure that the chances of malfunctioning of NIFPES are practically nil. To achieve this objective, the Contractor shall work out their scheme of activating signals which, while preventing mal-operation, should not be too rigorous to make the operation of NIFPES impracticable in case of actual need. Transformer isolation shall be the mandatory pre-requisite for activation of the system in Automatic mode or Remote mode in the control room.

In addition, at least following electrical-signals shall be provided in series for activating NIFPES.

7.19.5 Auto Mode

- | | | |
|---------------------------|---|---|
| a) For Prevention of Fire | : | <ol style="list-style-type: none"> i. Differential Relay Operation ii. Buchholz Relay parallel with Pressure Relief Valve or RPRR. (Rapid Pressure Release Relay) iii. Tripping of all concerned breakers is a prerequisite for initiation of system activation. |
| b) For Extinguishing Fire | : | <ol style="list-style-type: none"> i. Fire Detector ii. Buchholz Relay paralleled with Pressure Relief Valve or RPRR. iii. Tripping of all connected breakers is a prerequisite for initiation of system activation. |

7.19.6 Manual Mode (Local/Remote): Tripping of all connected breakers is a pre-requisite for initiation of system activation.

7.19.7 Manual Mode (Mechanical): Tripping of all connected breakers is a pre-requisite for initiation of system activation.

7.19.8 **General Description of NIFPES**

7.19.9 **Schematic of the System**

NIFPES should be a stand alone dedicated system for oil filled. It should have a fire extinguishing FE) cubicle placed on a plinth at a distance of 6-10 mtrs. from the transformer. The F.E. cubicle may be connected to the transformer oil tank (near its top) and to the oil pit from its bottom through oil pipes with gate valves. The F.E. cubicle should house a pressurized nitrogen cylinder connected to the transformer oil tank (near its bottom). Cable connections are to be provided from signal box placed on the transformer to the control box in the control room and from control box to F.E. cubicle. Fire detectors placed at the top of transformer are to be connected in parallel to the signal box. The signal box may be connected to a pre-stressed non-return valve fitted between the conservator tank and Buchholz relay. Control box is also to be connected to relay panel in control room for system activation signals.

7.19.10 Operation

On receipt of all activating signals, drain of pre-determined quantity of oil commences thus removing high temp. top oil layer. Simultaneously nitrogen is injected under high pressure at a pre-fixed rate, string the oil thus bringing the temperature of top oil layer down. Nitrogen occupies the space created by oil drained out and acts as an insulating layer between the tank oil & fire on top cover. Pre-stressed non return valve blocks oil flow form conservator tank, thus isolating it & preventing aggravation of fire.

7.19.11 System Components

Broadly, NIFPES shall consist of the following components. It is emphasized that all components, necessary for fast reliable & effective working of NIFPES shall be considered within the scope.

7.19.12 Fire Extinguishing Cubicle


It shall be made of 3mm thick steel sheet, painted dark red from inside & outside with hinged split doors fitted with high quality tamper proof lock. It shall be complete with the base frame and the following:-

- Nitrogen gas cylinder with regulator and falling pressure electrical contact manometer
- Oil drain pipe with mechanical quick drain valve.
- Electro mechanical control equipment for oil drain and pre-determined regulated nitrogen release.
- Pressure monitoring switch for back-up protection for nitrogen release.
- Limit switches for monitoring of the system.
- Flanges on top panel for connecting oil drain and nitrogen injection pipes for transformer.
- Panel lighting (CFL Type)
- Oil drain pipe extension of suitable sizes for connecting pipes to oil pit.

7.20 Control Box

Control Box for monitoring system operation, automatic control and remote operation, with following alarms indication, light switches, push buttons, audio signal, line fault detection suitable for tripping and signaling on 110V DC supply :

- System on*
- PNRV open*
- Oil drain valve closed*
- Gas inlet valve closed*
- PNRV closed^
- Fire Detector Trip^
- Buchholz Relay Trip^
- Oil drain valve open^
- Extinction in pressure^

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- Cylinder pressure low[^]
- Differential relay trip[^]
- PRV/RPRR trip[^]
- Transformer trip[^]
- System out of service
- Line fault free detector
- Line fault differential relay
- Line fault buchholz relay
- Line fault PRV
- Line fault transformer trip
- Line fault PNRV
- Auto/Manual/Off
- Extinction release on
- Extinction release off
- Lamp test
- Visual / Audio Alarm
- Visual / Audio alarm for DC supply fail

The signals marked (*) shall be in the topmost row of control box panel. The signals marked (^) shall follow next.

7.21 Pre-stressed Non Return Valve (PNRV)

PNRV is to be fitted in the conservator pipe line between conservator & Buchholz relay. It shall have the proximity switch for remote alarm, indication and with visual position indicator. The PNRV should be of the best quality because malfunction of PNRV shall be of serious consequence as its closing leads to stoppage of breathing of transformer.

7.22 Fire Detectors

The system shall be complete with adequate number of fire detectors fitted on the top of oil tank, OLTC/Off ckt. Tap changer rated for 1410C for heat sensing each fitted with two no. cable glands (water proof/weather proof).

7.23 Signal Box

It shall be fitted on the transformer for terminating cable connections from PNRV & fire detectors and for further connection to the control box.

7.24 Cables

Fire survival cables, able to withstand 7500C, 4 core x 1.5mm sq. for connection of fire detectors in parallel shall be used. Fire retardant low smoke (FRLS) cable 12 core x 1.5mm sq. for connection between transformer signal box/marshalling box to control box and control box to fire extinguishing cubicle shall be used.



Fire retardant low smoke (FRLS) cable 4 core x 1.5mm sq. for connection between control box to DC supply source and fire extinguishing cubicle to AC supply source, signal box marshalling box to prestressed non return valve connection on transformer shall be used.

7.25 Pipes

Pipes, complete with connections, flanges, bends, tees etc. shall be supplied alongwith the system.

7.26 Other items

- a) Oil drain and nitrogen injection openings with gate valves on transformer tank at suitable locations
- b) Flanges with dummy piece in conservator pipe between Buchholz relay and conservator tank for fixing PNRV.

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- c) Fire detector brackets on transformer top cover.
- d) Spare potential free contacts for system activating signals i.e. differential relay, buchholz relay, pressure relief valve, transformer isolation (master trip relay).
- e) Pipe connections between transformer to fire extinguishing cubicle and fire extinguishing cubicle to oil pit.
- f) Cabling on transformer top cover for fire detectors to be connected in parallel and inter cabling between signal box to control box and control box to fire extinguishing cubicle
- g) Mild steel oil tank with moisture proof coating with capacity as minimum 10% of total oil quantity of transformer, with water tight cover, to be place in the oil pit. This tank shall be provided with the manhole, air vent pipe through silica gel breather, drain valve and a spare gate valve at the top.
- h) Gate valves on oil drain pipe & nitrogen injection pipe should be able to withstand full vacuum. A non-return valve shall also be fitted on nitrogen injection pipe between transformers & gate valve.
- i) Pressure relief valve, wherever not fitted on the transformer.
- j) The F.E. cubicle shall be painted with post office red colour (Shade 538 of IS-5). All the exposed parts i.e. pipes, supports, signal box etc. shall be painted with enameled paint.

7.27 Modification on the transformer

No modification on the transformer shall be allowed which affects its performance (i.e. efficiency, losses, heat dissipation ability etc.), safety, life etc. or its any other useful parameter. This requirement shall be of paramount importance and shall be followed.

However, in any case, performance of transformer should not be affected in any manner by having NIFPES system and the Contractor shall give an undertaking to this effect. All pipes should be washed/rinsed with transformer oil. If any damage is done to the transformer and/or any connected equipment during installation & commissioning full recovery therefore shall be effected from the Contractor.



It shall be solely the responsibility of Contractor/Sub-Contractor to install, carry out pre-commissioning tests & commission NIFPES at Ridge Valley indicated in this Specification, to the entire satisfaction of the Owner/Consultant..

7.28 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 PNRV shall get closed only if all the connected breakers are open.

7.29 In general, following Fire Extinction period and other data shall be followed :

On commencement of Nitrogen Injection	:	Maximum 30 seconds
From the moment of system activation to complete cooling	:	Maximum 3 minutes
Fire detectors heat sensing temperature	:	141 ⁰ C
Heat sensing area	:	800mm radius
Pre-stressed non return valve setting for Operation	:	minimum 60 ltr. Per minute
Capacity of Nitrogen cylinder :	:	Minimum 68 litre water capacity And shall hold minimum 10 cubic Meter gas to 150 bar pressure
Power Source	:	
Control Box	:	220VDC

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Fire extinguishing cubicle for 230VAC lighting

7.30 The following information in detail shall be provided :

- a) The maintenance and testing schedule for NIFPES.
- b) All the steps required to be undertaken for restarting the transformer and connected equipment after operation and mal-operation (if any) of the NIFPES.
- c) The process of venting nitrogen in case nitrogen pressure in the cylinder exceeds the stipulated maximum value.

8.0 PAINTING



- 8.1 The surface to be painted shall be shot or sand blasted to remove all dust, scale and foreign adhering matter. All traces of oil and greases should be removed by suitable treatment.
- 8.2 All steel surfaces in contact with insulating oil shall be painted with heat resistant oil insoluble insulating varnish.
- 8.3 All steel surfaces exposed to outside shall be painted with suitable anti-rust and anticorrosive paints. Epoxy paints shall be used.
- 8.4 All paints shall be carefully selected to withstand tropical heat and extremes of weather. The paint shall not scale off, crinkle or be removed by abrasion due to normal handling.
- 8.5 The paint should not fade during drying process. The paint should be able to withstand temperature up to 120 deg. C .The detailed painting procedure shall also be submitted along with the bid which shall be finalized before award of the contract.
- 8.6 Unless otherwise specified, the finishing shade shall be light grey Shade No. 631 as per IS 5.
- 8.7 1 litre of paint per transformer shall be supplied for touch up at Site.

9.0 TESTS AND INSPECTION

- 9.1 All transformers shall be routine tested as per IS 2026. Transformer oil shall be tested as per IS 335. Heat run test shall be carried out for one transformer of each rating.
- 9.2 Type test certificate shall be furnished.
 - a. Temperature-rise tests (IEC 60076-2)
 - b. Dielectric tests: Full-wave impulse-voltage withstand test (IEC 60076-3)
- 9.3 Additional tests, wherever specified, shall be carried out on one transformer of each rating.
- 9.4 All the above mentioned tests shall be carried out in the presence of Purchaser's representative. In addition, the transformers shall be subject to stage inspection at works and inspection at site for final acceptance.
- 9.5 These inspections shall, however, not absolve the Vendor from their responsibility for making good any defect which may be noticed subsequently.

10.0 DRAWINGS AND DOCUMENTS

- 10.1 The drawings and documents as per Annexure-III shall be furnished, unless otherwise specified.
- 10.2 All drawings and documents shall have the following descriptions written boldly:
 - Name of Client
 - Name of Consultant
 - Enquiry / order number with plant / project name
 - Equipment Code No. and Description
- 10.3 The transformer shall be suitably packed to avoid damage in transit and shall be properly sealed so as to completely exclude oxygen and moisture from coming in contact with oil.

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Bushing shall be wrapped in straw ropes or similar material and complete transformer shall be packed in wooden crates.

- 10.4 The packing box shall contain a copy of the installation, operation and maintenance manual.
- 10.5 All loose pieces shall be separately wrapped in moisture resistant paper and marked with identification mark of the corresponding transformer.

11.0 SPARES

- 11.1 Commissioning Spares : Commissioning spares, as required, shall be supplied with the main equipment. Item-wise list of recommended commissioning spares shall be furnished for information.
- 11.2 Spares for 2 Years Operation (Mandatory), as specified shall be supplied.
- 11.3 List of Recommend Spares (other than Mandatory Spares) alongwith recommended quantity shall be furnished.
- 11.4 All spare parts shall be identical to the parts used in the equipment.

12.0 PACKING

- 12.1 The transformer shall be suitably packed to avoid damage in transit and shall be properly sealed so as to completely exclude oxygen and moisture from coming in contact with oil. Bushing shall be wrapped in straw ropes or similar material and complete transformer shall be packed in wooden crates.
- 12.2 The packing box shall contain a copy of the installation, operation and maintenance manual.
- 12.3 All loose pieces shall be separately wrapped in moisture resistant paper and marked with identification mark of the corresponding transformer.



ANNEXURE - I LIST OF FITTINGS

I. The fittings as given below shall be provided for all the ratings of transformers.

1. Oil Sampling Valve.
2. Filter valves with plug.
3. Radiator shutoff valves on top and bottom for each unit.
4. Buchholz relay shutoff valves.
5. Winding temperature indicator for 1000 KVA and above.
6. Oil temperature indicator.
7. Oil level indicator with minimum marking.
8. Oil conservator complete with drain plug and oil filling hole with cover.
9. Buchholz relay with air release device and alarm and trip contacts.
10. Silica gel breather with oil seal and connecting pipe.
11. Explosion vent.
12. Bi-directional rollers.
13. Inspection holes with cover.
14. Marshalling Box.
15. Rating Plate.
16. Diagram and Terminal marking plate.
17. Lifting lugs.
18. Jacking pad.
19. Earthing Terminals.
20. Air release device.
21. Neutral bushing for earthing.
22. Ladder with safety device for access to the top of transformer tank.

II. The additional fittings as given below shall also be provided, as per requirement:

1. Magnetic oil level gauge with low oil level alarm contact.
2. Hauling lugs for extra high voltage transformers.
3. Protective CTs for
 - a) Stand-by earth fault.
 - b) Restricted earth fault.
 - c) Differential protection.
4. Bi-directional wheels if already bi-directional rollers not considered.
5. Skids.
6. Cooler units complete with valves, fans, pumps, oil flow indicators, supporting structure with fixing and foundation bolts etc as required and Cooler Control panel.
7. Tap-changing gear complete with tap position indicator, operation counter etc. For OLTC gear(where specified), oil surge relay(OSL) with shut-off valve, Local control cabinet.
8. Nitrogen Injection Fire Prevention and Extinguishing System

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ANNEXURE - II
DOCUMENTATION FOR TRANSFORMERS

Sl. No.	Description	Documents Required (Y / N)		
		With Bid	For Approval	Final
1.	Specification Sheet	N	Y	Y
2.	Technical Particulars	N	Y	Y
3.	Dimensional drawing for complete Transformer, Marshalling Box, disconnecting chamber, terminal chambers etc.	N	Y	Y
4.	Schematic and Wiring Diagram	N	Y	Y
5.	Terminal arrangement drawing	N	Y	Y
6.	Installation, operation and maintenance manual	N	N	Y
7.	Catalogues and test certificates for bought out accessories	N	N	Y
8.	Type test certificates of similar transformer	N	N	Y
9.	Test Certificates	N	N	Y
10.	Guarantee Certificates	N	N	Y
11.	Spare parts list with identification marks	N	N	Y

Note:

1. 4 hard copies & 1 soft copy shall be supplied for approval after order within 4 weeks from the date of LOI.
2. 8 hard copies & 2 soft copies in CD shall be submitted as final documents prior to despatch of the equipment. These shall be made in sets and supplied in fine plastic coated folder.

Y - Yes, N - No



TALCHER FERTILIZERS LIMITED
TECHNICAL SPECIFICATION - NEUTRAL EARTHING
RESISTORS

PC183-TS-0804

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TECHNICAL SPECIFICATION
NEUTRAL EARTHING RESISTOR



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4.0	OPERATING REQUIREMENTS
5.0	GENERAL DESIGN AND CONSTRUCTIONAL FEATURES
6.0	ACCESSORIES
7.0	PAINTING
8.0	TESTS AND INSPECTION
9.0	DRAWINGS AND DOCUMENTS
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ANNEXURE - I	DOCUMENTATION FOR NEUTRAL EARTHING RESISTORS

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1.0 SCOPE

- 1.1 This standard covers the technical requirements of design, manufacture, testing at works and despatch in well packed condition of Neutral Earthing Resistor for earthing the neutral of power transformers / generators for limiting the line to ground fault current.
- 1.2 This standard shall be read in conjunction with the relevant part of Design Philosophy – Electrical.

2.0 STANDARDS TO BE FOLLOWED

- 2.1 The design, manufacture and testing of the equipment covered by this standard shall comply with the latest issue of IS 3043, unless otherwise specified. Equipment complying with equivalent IEC standards shall also be acceptable.
- 2.2 The design and operational features of the equipment shall also comply with the provisions of latest issue of the Indian Electricity Rules and other relevant Statutory Acts and Regulations. The supplier shall, wherever necessary, make suitable modifications in the equipment to comply with the above.
- 2.3 Wherever any requirement, laid down in this standard, differs from that in Indian Standard Specifications, the requirement specified herein shall prevail.

3.0 SERVICE CONDITIONS

3.1 Ambient Conditions

These shall be as indicated in Design Philosophy – Electrical.

3.2 System Details

These shall be as indicated in Design Philosophy – Electrical.

4.0 OPERATING REQUIREMENTS

- 4.1 The neutral earthing resistor shall be suitable for carrying the rated current for duration of 30 seconds under the specified ambient conditions and voltage and frequency variations without the temperature exceeding 350°C.
- 4.2 The resistor shall be designed to carry continuously 20% of the rated short time current without any harmful effect.
- 4.3 The housing shall be sized such that temperature rise of the metal parts through which current is not required to pass, when rated current is passed for the specified period, shall not exceed 40°C.

5.0 GENERAL DESIGN AND CONSTRUCTIONAL FEATURES

5.1 Resistors

- 5.1.1 The resistance bank shall be of heavy duty non-inductive type having high specific resistance and low temperature co-efficient.
- 5.1.2 The resistor elements shall be made of joint-less, non-corroding, sturdy and oxidation resistant AISI 304 / AISI 406 stainless steel of punched / formed construction.
- 5.1.3 The contact between elements shall be made by individually bolting the terminals of two adjacent elements and connecting them in series, parallel or combination of both to achieve the specified resistance. The interconnecting link shall be zinc plated copper of uniform cross section throughout.
- 5.1.4 The resistance grid shall be properly supported so that damage due to vibration and thermal or mechanical stresses is avoided.

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5.1.5 Porcelain / Epoxy insulators rated for the highest system voltage shall be used to insulate the resistor elements from the body of the housing.

5.1.6 Insulation level for resistor bank shall be as follows:

Highest system voltage	Power frequency withstand voltage	Impulse withstand Voltage
Up to 3.6 KV peak	10 KV RMS	40 KV
7.2 KV peak	20 KV RMS	60 KV

5.2 Metal clad housing

5.2.1 The housing shall be fabricated out of 3 mm thick sheet steel fitted on a 6 mm thick mild steel frame work. This shall be floor mounting type and rectangular in shape.

5.2.2 It shall be suitable for outdoor installation and shall have minimum degree of protection IP: 43 as per IS 2147. Ventilating louvers, if provided, shall be covered by fine wire mesh from inside and shall be such that the above degree of protection for the enclosure is not altered. Top cover of the housing shall be slopping construction to prevent accumulation of water.

5.2.3 All external hardware below 8 mm size shall be of stainless steel and those of higher size of mild steel cadmium plated or zinc passivated.

5.3 Isolation Arrangement

5.3.1 An isolator shall be provided on the incoming side to isolate the resistors from the main equipment.

5.3.2 The isolating switch shall be single pole knife type having a rating of 1.5 times the rated current of the resistor. The switch shall have four sets of potential free auxiliary contacts, 2 NO and 2 NC for remote indication, wired to a terminal block. An external handle, suitably insulated and lockable both in the ON and OFF positions, shall be provided for the switch. The handle shall preferably be mounted at a height of 1.5 meters from the base of the housing.

5.4 Current Transformers

Epoxy moulded current transformer of accuracy 5P for stand by earth fault protection and PS for restricted earth fault protection shall be provided, as per requirement. The CT connections shall be brought to separate terminal box with shorting arrangement.

5.5 Terminal Arrangement

5.5.1 For incoming connection, either bushing or cable box arrangement shall be provided. In case of bushing connection, the bushing shall be provided on top of the housing. In case of cable box connection, the same shall be mounted on the side of the housing.

5.5.2 For the outgoing connection, cable box arrangement is to be considered in all cases. The cable box shall be mounted on the side of the housing.

5.5.3 Heavy duty double compression type rolled aluminium cable glands shall be provided for all the incoming and outgoing cables.

5.5.4 The equipment terminals shall be anti loosening type and complete with tinned copper cable lugs suitable for cables of specified size. For bushing connections, suitable tinned copper conductor shall be provided as per conductor size specified.

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6.0 ACCESSORIES

6.1 The equipment shall be complete with cable glands, cable lugs, drain plug, lifting hook, name plate, foundation bolts and all other accessories required to make the equipment complete in all respects.

6.2 Name Plate

6.2.1 Name plate shall be of stainless steel with letters embossed on them.

6.2.2 The name plate shall contain all the required details and shall include at least the following:

- i) Make
- ii) Description of code no. of equipment
- iii) Short time rating
 - a) Current
 - b) Duration
- iv) Rated voltage
- v) Maximum temperature rise over ambient
- vi) Total resistance at ambient temp.
- vii) Materials of resistors
- viii) Degree of protection of enclosure

7.0 PAINTING

7.1 The enclosure, after suitable pre-treatment shall be painted with two coats of antirust paint followed by two coats of anti-corrosive paints.

7.2 Epoxy based paints shall be used.

7.3 All paints shall be carefully selected to withstand tropical heat and extremes of weather. The paint shall not scale off, crinkle or be removed by abrasion due to normal handling.

7.4 The finishing paint shall be light grey shade no. 631 as per IS 5.

8.0 TESTS AND INSPECTION

8.1 Following tests shall be carried out on the neutral earthing resistors:

8.1.1 Routine Tests

- i) Resistance value measurement at room temperature.
- ii) Power frequency high voltage test for one minute.
- iii) Insulation resistance test.

8.1.2 Type test

- i) Heat run test.

8.2 The above mentioned tests shall be carried out in the presence of purchaser's representative. In addition, the equipment shall be subjected to stage inspection during process of manufacture at works and inspection at site for final acceptance.

8.3 The purchaser's inspection shall, however, not absolve the vendor from his responsibility for making good any defects which may be noticed subsequently.

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9.0 DRAWINGS AND DOCUMENTS

- 9.1 The drawings and documents as per Annexure-I shall be furnished unless otherwise specified.
- 9.2 All drawings and documents shall have following descriptions written boldly.
- Name of the client
 - Name of consultant
 - Enquiry / order number with plant / project name
 - Equipment code no. and Description.

10.0 SPARES

- 10.1 Commissioning Spares : Commissioning spares, as required, shall be supplied with the main equipment. Item-wise list of recommended commissioning spares shall be furnished for information.
- 10.2 Spares for 2 Years Operation (Mandatory), as specified shall be supplied.
- 10.3 Recommend Spares (other than Mandatory Spares) alongwith recommended quantity shall be furnished.
- 10.4 All spare parts shall be identical to the parts used in the equipment.

11.0 PACKING

- 11.1 The neutral earthing resistor shall be properly packed to safeguard against weather conditions and handling. It shall be wrapped in polythene bag with an additional wrapping of bitumen paper to make it completely waterproof before the equipment is packed in wooden crates.
- 11.2 A sign to indicate the upright position of the panel for placing during transport and storage shall be clearly marked.
- 11.3 Packing box shall include one copy of the installation operation and maintenance manual



ANNEXURE - I

DOCUMENTATION FOR NEUTRAL EARTHING RESISTORS

Sl. No.	Description	Documents Required (Y / N)		
		With Bid	For Approval	Final
1.	Specification Sheet	N	Y	Y
2.	Technical Particulars	N	Y	Y
3.	General arrangement drawings	N	Y	Y
4.	Illustrative and descriptive catalogues	N	N	Y
5.	Installation, Operation and maintenance manual	N	N	Y
6.	Test Certificates	N	N	Y
7.	Guarantee Certificates	N	N	Y

Note:

1. 4 hard copies & 1 soft copy shall be supplied for approval after order within 4 weeks from the date of LOI.
2. 8 hard copies & 2 soft copies in CD shall be submitted as final documents prior to despatch of the equipment. These shall be made in sets and supplied in fine plastic coated folder.

Y - Yes, N - No



TALCHER FERTILIZERS LIMITED
TECHNICAL SPECIFICATION - MEDIUM VOLTAGE
SWITCH BOARDS

PC183-TS-0805

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TECHNICAL SPECIFICATION
MEDIUM VOLTAGE SWITCH BOARDS

CONTENTS

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5.0	DESIGN AND CONSTRUCTIONAL FEATURES
6.0	COMPONENT DETAILS
7.0	ACCESSORIES
8.0	PAINTING
9.0	TESTS AND INSPECTION
10.0	DRAWINGS AND DOCUMENTS
11.0	SPARES
12.0	PACKING
ANNEXURE - I	DOCUMENTATION FOR MEDIUM VOLTAGE SWITCH BOARDS

1.0 SCOPE

- 1.1 This standard covers the technical requirements of design, manufacture, testing at works and delivery in well-packed condition of Medium Voltage Switchboards.
- 1.2 This standard shall be applicable for the Power Control Centres, Power cum Motor Control Centres and Motor Control Centres.
- 1.3 This standard shall be read in conjunction with relevant part of Design Philosophy – Electrical, Schematic diagrams etc.

2.0 STANDARDS TO BE FOLLOWED

- 2.1 The design, manufacture and testing of the equipment shall comply with the latest issue of the following Indian Standards, unless otherwise Specified. Equipment complying with equivalent IEC standards shall also be acceptable.

- | | |
|--------------|--|
| IS 8623 | - Specification for low voltage switchgear and control gear assemblies |
| IS/IEC 60947 | - Low-voltage switchgear and control gear (General Rules) |
| IS 5578 | - Guide for marking of insulated conductors |
| IS 10118 | - Code of practice for selection, installation and maintenance of switchgear and control gear |
| IS 11353 | - Guide for uniform system of marking and identification of conductors and apparatus terminals |

Various components housed in the switchboards shall conform to the Indian Standard specifications as mentioned against the component details or IEC specifications.

- 2.2 The design and operational features of all the equipment offered shall also comply with the provisions of the latest issue of the Indian Electricity Rules and other Statutory Acts and Regulations, as applicable. The supplier shall, wherever necessary, make suitable modifications in the equipment to comply with the above.
- 2.3 Wherever any requirement, laid down in this standard, differs from that in Indian Standard Specification / IEC Specification, the requirement specified herein shall prevail.

3.0 SERVICE CONDITIONS

3.1 Ambient Conditions

These shall be as indicated in Design Philosophy – Electrical.

3.2 System Details

These shall be as indicated in Design Philosophy – Electrical.

4.0 OPERATING REQUIREMENTS

The Medium Voltage Switchboards shall be suitable for operating at the specified rating continuously, with the specified voltage and frequency variations under the ambient conditions, without exceeding the permissible temperature rise and without any detrimental effect on any part.

5.0 DESIGN AND CONSTRUCTIONAL FEATURES

5.1 General

- 5.1.1 The switchboards shall consist of an assembly of a series of floor mounting, identical, metal clad, dead front type sheet steel panels of unitized design. The panels shall be placed side by side to form a compact assembly and shall be extensible on either side.
- 5.1.2 The complete assembly shall be dust, damp and vermin proof having minimum degree of protection equivalent to IP-52 up to 1600A rating and IP-4X above 1600A rating as per IS/IEC:60947.
- 5.1.3 The frame work of the cubicles shall be of bolted/welded construction. The minimum thickness of sheet steel shall be 2 mm for load bearing members, 1.6 mm for non-load bearing members and 3 mm for base channel. The doors and covers shall be fabricated from cold rolled sheets. Suitable reinforcement, wherever necessary, shall be provided.
- 5.1.4 The door hinges shall be concealed type.
- 5.1.5 All external hardwares shall be cadmium plated. The hardwares for fixing the removable parts shall be provided with retaining devices.
- 5.1.6 The doors and the removable covers shall be provided with non-deteriorating neoprene gaskets. Gaskets without any discontinuity shall be preferred. Gaskets shall be held in position in groove, in shaped sheet steel work or these shall be of U type. Adhesive cement, if used, shall be of good quality so that the gaskets do not come off during service.
- 5.1.7 All the components shall be accessible for inspection and maintenance without the necessity for removal of the adjacent ones.
- 5.1.8 The layout of the component inside the module shall be liberal to facilitate maintenance and interconnecting wiring between the components shall not be subjected to any undue stresses at the bends.
- 5.1.9 Mounting height of components requiring operations and observation shall not be lower than 300 mm and higher than 1800 mm.
- 5.1.10 Inter panel barriers shall be provided.
- 5.1.11 All the live parts which are accessible after opening of front cover/cable alley cover/back cover shall be properly insulated or provided with insulating barrier to prevent accidental contact. Removal facility shall be provided for all such parts.
- 5.1.12 Adequate arrangement for earthing shall be provided to safeguard the operator or other personnel from electric hazards under all conditions of operation.

5.2 Panel Arrangement

The Switchboards shall be in fixed/draw out, single front execution, fully compartmentalised type and divided into distinct panels, each comprising of :

- i) A completely metal enclosed bus-bars compartment running horizontally the top.
- ii) Individual feeder modules.
- iii) Enclosed vertical bus-bars serving all modules, in case of multi-tier panels.
- iv) A vertical cable alley.
- v) Separate horizontal enclosure for all auxiliary power and control buses.

5.3 Circuit Breaker Controlled Feeders

- 5.3.1 The panels housing circuit breaker feeders shall be in single front draw out execution. The incoming and bus coupler circuit breaker feeders shall be in single tier formation while the outgoing circuit breaker feeders may be in double tier formation.

- 5.3.2 A suitable barrier shall be provided between the circuit breaker and the associated control, protective and indication devices including instrument transformers.
- 5.3.3 All the protective relays and meters shall be flush mounted type. The relays and meters pertaining to a particular circuit breaker shall be mounted on the same panel. Where it is not possible to accommodate all the relays and meters in the same panel, one metering panel shall be provided adjacent to the circuit breaker panel exclusively for that feeder. Location of these in the adjacent panel of other feeders shall not be acceptable.
- 5.3.4 A spacious cable chamber suitable for accommodation, support and termination of required number of power cables shall be provided at the back. No bare bus-bars or live connection shall intrude into the cabling space.
- 5.3.5 The switchboard shall be provided with following inter locks and safety features:
- i) It shall not be possible to open the compartment door unless the breaker is drawn to isolated position.
 - ii) The withdrawn and engagement of a circuit breaker shall not be possible unless it is in open position.
 - iii) The operation of a circuit breaker shall not be possible unless it is in fully service, test or isolated position.
 - iv) It shall not be possible to close the circuit breaker in service position unless all auxiliary and control circuits are connected.
 - v) A breaker of the lower rating shall be prevented from engaging with the stationary element of higher rating.
 - vi) Insertion of the manual mechanism shall render the motorised mechanism in operation.
 - vii) Circuit breaker 'ON', 'OFF' indication shall be provided at the back of each panel. Alternatively, alarm shall be provided in case panel back door is opened with breaker "ON".
 - viii) Caution nameplate shall be provided at the back of incomer's panels where terminals are likely to remain live and isolation is possible only from remote end.
 - ix) Automatic safety shutter, with Padlocking facility for locking in closed position, to completely cover the spouts for the bus-bars and cable connection when the breaker is withdrawn.
- 5.4 **Switch/MCCB Controlled Feeders**
- 5.4.1 The panels housing motor starter or other feeders shall be either fixed or draw out type in single front execution.
- 5.4.2 All components of one feeder shall be mounted on a rigid sheet steel chassis.
- 5.4.3 Each panel shall be divided into a number of modules in tier formation placed one above the other. These modules shall be closed on all sides.
- 5.4.4 The modules shall be so placed that largest one is placed at the bottom of the panel. Type modules shall be at least 300 mm from the base channel.
- 5.4.5 The number of modules shall be so decided that the cables in the cable alley are not over crowded. However the number of module in any panel shall not exceed six.
- 5.4.6 The minimum size of module shall be 300 mm and 200 mm for starter and switch fuse feeders respectively.
- 5.4.7 The minimum clear width of cable alley shall be 250 mm.

- 5.4.8 For MCC rated above 630 Amp. The incomer and bus coupler modules shall be located in individual single panel. For MCC rated for 630 Amp. and below the incomer and bus coupler modules shall be half the panel size.
- 5.4.9 The module door shall be so interlocked that it shall not be possible to open the door with switch in closed position and close the door unless the module is fully plugged in. Defeat interlock facility shall be provided.
- 5.5 Special Features of Draw out Modules**
- 5.5.1 The module shall be fully draw out type with sheet steel chassis moving freely on the guides. Chassis of the same size shall be fully interchangeable.
- 5.5.2 The module shall have the following distinct mechanical positions:
- i) Service -- In which both power and control contacts shall be made.
 - ii) Test -- In which power contacts shall be isolated but control contacts shall be made.
 - iii) Isolated -- In which both power and control contacts shall be Isolated.
- Maintenance position shall be preferred.
- 5.5.3 Each position shall be clearly marked. Padlocking facility shall be provided to padlock the chassis in any of the position.
- 5.5.4 The movement of the chassis from one position to the other shall be controlled by using an appropriate racking mechanism. Stopper shall be provided to prevent over travel of the chassis beyond the isolated position.
- 5.5.5 The guiding system shall permit smooth movement of the module and the power and control contacts shall be self-aligning type so that accurate alignment of the contacts is ensured.
- 5.5.6 No wiring shall be taken to the door. Only the actuators of the push buttons and switches, lenses for the indicating lamps and Perspex cover for meters shall be mounted on the door.
- 5.5.7 The power contacts shall be of plug-in/stab-in type made of silver plated copper, spring loaded and of adequate current carrying capacity. The contacts shall be so designed that contact pressure is maintained both under normal and short circuit conditions.
- 5.5.8 The parting contacts, both on bus-bar side and outgoing cable side, shall always be copper to copper and both sides silver plated. A bimetallic strip shall be used where two dissimilar materials are in contact.
- 5.6 Bus-Bars and Connections**
- 5.6.1 The bus-bars shall be for three phase and neutral. The main bus-bars and connections shall be made of electrolytic grade copper of rectangular cross-section. Auxiliary bus-bars for control supply, space heater supply etc. shall be made of electrolytic copper.
- 5.6.2 The horizontal bus-bars shall be insulated with heat shrinkable PVC sleeves of reputed make to protect against approach to live parts. The vertical bus-bars shall be sleeved or shrouded by barriers. Removable type insulating shrouds shall be provided for all joints of horizontal bus-bars.
- 5.6.3 The bus-bars shall be amply sized to carry the rated continuous current under the specified ambient temperature without exceeding temperature limits specified in IS: 8084. The thermal rating of the bus-bars shall be designed to withstand the system fault current for 1 second without exceeding the limiting temperature of 200°C for bare Aluminium/Copper. Calculation for bus-bars sizing shall be furnished along with the offer.

- 5.6.4 Horizontal bus-bars shall be of the same cross-section through out. Stepped bus-bars shall not be acceptable.
- 5.6.5 The bus-bars shall be arranged and colour coded according to IS: 5578 / IS: 11353.
- 5.6.6 The bus-bar chamber shall be sufficiently spacious and shall have separate screwed covers for maintenance purpose.
- 5.6.7 The bus-bars shall be rigidly supported at equal intervals to withstand maximum short circuit stresses. The supports shall be of moulded construction with built-in anti-tracking barriers. The support materials shall be of DMC or fibreglass reinforced thermosetting plastic.
- 5.6.8 Bus-bar joints shall be between the two transporting sections only.
- 5.6.9 A minimum of two bolts shall be used in bus-bar joints. Only high tensile electric galvanized bolts, nuts and washers shall be used.
- 5.6.10 In case of Aluminium bus-bars, all joints shall be suitably treated to avoid oxidation of contact surfaces and bimetallic corrosion.

5.7 **Earth Bus**

A continuous earth bus of electrolytic grade copper, running along the entire length of the lower part of the switchboard shall be provided with lugs at two ends for external connections. The minimum size of earth bus shall be suitable for carrying three phase fault current for 1 sec.

5.8 **Bus Duct**

- 5.8.1 Suitable extension of bus-bars in proper phase sequence on the top, with the connecting bolts shall be provided where connection of transformer to switchboard is specified to be through bus duct.
- 5.8.2 Bus duct between two halves of a switchboard, if required, shall be supplied by the switchboard manufacturer. The bus-bars of interconnecting bust duct shall be similar to the main bus-bars of the switchboard and as specified above.
- 5.8.3 Bust duct between transformer and incoming breaker panel, if included in Vendor's scope, shall conform to ES-8062.

5.9 **Clearances and Creepage Distances**

- 5.9.1 The clearances and creepage distances shall not be lower than the values specified below:

- | | | | |
|------|--|----|-------|
| i) | Minimum clearance between two live conductors | -- | 20 mm |
| ii) | Minimum clearance between live parts and accidentally dangerous part | -- | 20 mm |
| iii) | Minimum creepage distance | -- | 28 mm |

- 5.9.2 The clearances and creepage, as specified above, shall definitely be maintained in the bus-bar system. Provision of bus-bar insulation, separators or barriers shall not be considered to reduce the clearance from the values specified above.

- 5.9.3 At the termination points in the equipment e.g. switches, contactors, thermal relays etc. It is realized that above clearances may not always be possible to be maintained. All such points, where above clearances and creepage distances are not possible to be maintained, shall be insulated or taped.

5.10 **Insulation**

- 5.10.1 The insulation used shall be non-hygroscopic and may be of porcelain, epoxy resins or fibreglass moulded with plastic. It shall be of adequate electrical, mechanical and

thermal strength to give trouble free service during normal operation and short circuit conditions.

5.10.2 The insulation shall be treated suitably to withstand the tropical conditions and atmospheric pollution.

5.11 **Power Wiring**

5.11.1 The connections from bus-bar to individual functional unit on the modules shall be of PVC insulated flexible copper cables or taped Copper/Aluminium strip.

5.11.2 The power wiring size shall be decided based on rating of the switch/breaker after using a rating factor of not more than 50% over the current rating in free air.

5.11.3 Power wiring size selected for breaker controlled module shall also be able to withstand full short circuit current for duration of 0.25 sec.

5.11.4 In any case minimum size of power wiring shall not be less than 4 sq. mm copper.

5.11.5 The size of connection from incomer to horizontal bus-bar and from horizontal bus-bar to bus-coupler shall not be less than the size adopted for horizontal bus-bar.

5.12 **Control Wiring**

5.12.1 The switchboard shall be completely factory wired and ready for external connections.

5.12.2 The wiring shall be carried out with flexible stranded PVC insulated copper conductor cables of 1100 Volt grade. The size of wires shall be as follows:

C.T. Circuit -- 2.5 sq. mm

V.T. and Control Circuits -- 1.5 sq. mm

5.12.3 All wiring shall be provided with dependent both ends marking as per IS: 5578. Numbered ferrules, reading from the terminals outwards, shall be provided at both ends of all wiring for easy identification. These shall be interlocking type plastic ferrules.

5.12.4 Control wiring circuits, fed from a supply common to a number of panels, shall be so protected that failure of a circuit in one panel does not effect the operation of the other panels.

5.12.5 The wiring to the equipment mounted on the doors shall be carried out with flexible multi strand copper conductor cable and so supported that on opening of the door there is no undue strain on wire leads.

5.12.6 The control cables shall be neatly arranged and property supported.

5.13 **External Cable Termination**

5.13.1 All power and control cables shall enter the switchboard from the bottom. Sufficient space shall be provided for ease of connection and termination of cables.

5.13.2 The type, number and sizes of cables shall be as indicated in Feeder details.

5.13.3 Compression type cable glands along with the cable lugs as required shall be provided for termination of cables.

5.13.4 The cable glands shall be of rolled Aluminium heavy duty double compression type and shall be mounted on a removable gland plate, provided at a minimum height of 75 mm from the bottom of the switchboard. Two number spare knockouts of size 20 mm shall also be provided on the gland plates for future use. Gland for termination of single core cables shall be nonmagnetic type.

5.13.5 For all power cables, crimped type Aluminium lugs for Aluminium cables and tinned Copper lugs for Copper cables shall be provided.

5.13.6 The terminal blocks shall be pressure clamp type up to 35 sq. mm cable sizes and bolted lug type for higher sizes of cables. These shall be protected type and rated for

1100 Volts service. The minimum current rating of terminal block shall be 16 Amp. The construction shall be such that after the connection of cables by means of lugs, necessary clearance and creepage distance are available.

5.13.7 Where more than two cables in parallel are required to be terminated, a system of bus links shall be provided with adequate clearance and spacing.

5.13.8 Suitable clamps to support the vertical run of cables shall be provided.

5.13.9 The terminal block shall be grouped according to circuit functions and suitably numbered. 20% extra terminals shall be provided in the terminal block.

5.13.10 For power connections, suitable marking on the terminals shall be provided to identify the phases.

5.14 **Feeder Details**

5.14.1 The requirements of incomer, bus coupler and outgoing feeders shall be as indicated in the single line diagram, feeder details and corresponding schematic diagrams.

5.14.2 Interlocks shall be provided between incomers and bus section panels. The interlocks shall be either electrical or mechanical type. In addition, arrangement for defeating the interlock shall also be provided to facilitate manual changeover.

5.14.3 Auto changeover scheme, wherever specified, shall be provided.

5.15 **Dummy Panels**

Dummy panels complete with bus-bar system in 400 mm width may be required for which unit price shall be indicated.

5.16 **Control Power Supply**

5.16.1 D.C. Power required for closing, tripping and indication of circuit breaker feeders shall be supplied at the bus coupler panel through two completely separate circuits by owner, one for tripping and other for closing and indication.

5.16.2 For receiving each external control supply, a double pole miniature circuit breaker shall be provided. This power shall be distributed inside the switchboard for each circuit breaker feeder having its MCB unit.

5.17 **Space Heater Power Supply**

5.17.1 Panel space heater shall be fed from a separate bus common for the whole board. This bus shall be fed from owner's supply for which a double pole MCB shall be provided in bus section panel.

5.17.2 Power supply for space heaters of motors shall be tapped from this bus by means of a MCB located in the motor feeder compartment. These MCBs shall be of triple pole and rated for 15 Amp.

6.0 **COMPONENT DETAILS**

Components of the switchgear shall ensure type of coordination 'C' as per IS:60947 (Part 4/ Section 1). Makes of all components shall be subject to owner's / consultant's approval

6.1 **Circuit Breaker**

6.1.1 The circuit breakers shall comply with the requirement of IS/IEC 60947.

6.1.2 All circuit breakers shall be of P2 (0-3 min - CO - 3 min - CO) category, capable of carrying the specified current at the site conditions and making/breaking of the system fault current.

- 6.1.3 Type test certificates from an independent testing authority shall be furnished along with the offer for each circuit breaker rating and type.
- 6.1.4 The circuit breakers controlling motors shall be suitable for DOL starting and stopping of induction motor a number of times.
- 6.1.5 The circuit breakers controlling capacitors shall be suitable for energizing and de-energizing the rated capacitor bank.
- 6.1.6 The circuit breakers shall be of the 3 phase, 4 pole horizontal draw out, horizontal isolation, air break type.
- 6.1.7 The circuit breaker shall be suitable for electrical or manual closing as specified. Manual operated breakers shall have independent manual spring closing mechanism. In case of electrically operated breaker, it shall have motor wound spring mechanism. In all cases tripping shall be by means of shunt trip coil.
- 6.1.8 All circuit breaker units of the same rating shall be physically and electrically interchangeable.
- 6.1.9 The circuit breakers shall be electrically and mechanically trip free and provided with anti-pumping feature.
- 6.1.10 Provision shall be made for slow closing for maintenance purposes. A suitable handle shall be provided one for each board for this purpose.
- 6.1.11 The circuit breakers shall have three positions i.e. service, test and isolated with the cubicle door closed. Necessary stoppers shall be provided to prevent the excessive movement of the breaker cradle than desired for the position. Service and test positions of the breaker shall have monitoring switch having 1NO+1NC contacts.
- 6.1.12 The circuit breaker shall be provided with emergency manual trip device, mechanical 'ON', 'OFF' and 'ISOLATED' position indicators and operation counter.
- 6.1.13 A maintenance truck/device for raising, lowering and withdrawal of the circuit breaker shall be supplied for each switch board.
- 6.1.14 The arc interrupting devices shall be capable of interrupting satisfactorily current from zero to the rated interrupting current when used on predominantly capacitive or inductive circuits, without requiring excessive maintenance of the contacts. The arc shall be restricted within the interrupting chamber and no emission of flame shall be allowed which may cause electrical breakdown or damage to insulation on the apparatus.
- 6.1.15 The main contacts shall be self aligning, adjustable and replaceable type.
- 6.1.16 The arcing contacts shall be easily accessible for maintenance and inspection and shall be easily replaceable type. They shall be provided with, contact face of special arc-resisting and non-pitting metal.
- 6.1.17 Mechanical safety interlock shall be provided for safe operation and movement of the breaker.
- 6.1.18 The circuit breakers shall be provided with minimum of four normally open and four normally closed auxiliary switch contacts, over and above those required for its own control scheme, for Owner's use. The contacts shall be wired separately to the terminal board.
- 6.2 Moulded Case Circuit Breakers**
- 6.2.1 The circuit breaker shall conform to IS/IEC 60947 and shall be of P2 category having rupturing capacity as per system requirement and mounted on a draw out chassis.
- 6.2.2 The circuit breaker shall be provided with spring assisted quick make quick break type manually operated trip free mechanism, mechanical 'ON', 'OFF' position indicators,

thermal tripping devices of inverse characteristics, instantaneous short circuit tripping devices and necessary auxiliary and alarm switches. The MCCB Chassis shall be provided with service, test and isolated position and automatic safety shutter.

- 6.2.3 The thermal and short circuit tripping devices shall be adjustable type.
- 6.2.4 When used for motor circuits, shunt trip device shall be provided and the let through power of controlling MCCB shall be lower than the respective contactor.
- 6.2.5 In addition, under voltage trip shall be provided.

6.3 Switches

- 6.3.1 The switches shall be motor duty type AC 23 Category and shall comply with the requirements laid down in IS/IEC 60947. Switches up to 63 Amps shall be rotary type and those of 100 Amps. & above, link type.
- 6.3.2 'ON' and 'OFF' position of the switches shall be indicated on the module. Provision shall be made to lock the switch in the 'OFF' position.
- 6.3.3 The fixed contacts shall be shrouded type. All contacts shall be silver plated.

6.4 Fuses

- 6.4.1 The fuses shall be of non-deteriorating HRC cartridge link type and shall conform to IS: 13703. They shall be suitable for the load and service required in the circuit.
- 6.4.2 One fuse puller shall be supplied along with each board.

6.5 Air Break Contactors

- 6.5.1 The Air Break Contactors shall be of Category AC3/AC4, unless otherwise specified, conforming to IS: 60947 and flapper type.
- 6.5.2 The dropout voltage shall not exceed 65% of rated voltage.
- 6.5.3 Each contactor shall be provided with auxiliary contacts as required. The rating of the auxiliary contacts shall be 5 Amps. AC or 1 Amp DC at the specified control voltages. The spare auxiliary contacts shall also be wired up to the terminal blocks.

6.6 Bimetal Thermal Overload Relays

- 6.6.1 The contactor shall be provided with three pole bimetal thermal overload relays, unless other-wise specified. The bimetal relays shall be of suitable range, ambient temperature compensated and shall be separate mounting type. They shall be adjustable through graduated scale and shall be provided with changeover contact. Thermal relays having long time/current characteristics, operated through saturated C.T.s shall be supplied, wherever required.
- 6.6.2 Bimetal thermal relays shall conform to IS: 3231 and IS/IEC 60947 and shall have built-in single phasing preventor.
- 6.6.3 The bimetal relays shall be provided with a manual resetting device resetable after opening module door. Auto reset thermal relays are not acceptable.

6.7 Current Transformers

- 6.7.1 The current transformers shall conform to IS: 2705.
- 6.7.2 C.T.s shall be Class F insulated and vacuum impregnated or resin cast. The C.T.s shall be rigidly mounted and shall be easily accessible for maintenance and testing.
- 6.7.3 The short time thermal withstand ratings of C.T.s shall be same as the thermal withstand rating of the breakers.
- 6.7.4 The C.T.s output shall be minimum 15VA for breaker feeders and 7.5 VA for the other feeders per phase and in any case, the output shall be adequate for the protection and

metering duties involved with sufficient margin. The C.T.s shall have the following accuracies for the various applications:

Application	Class of accuracy as per IS: 2705
--------------------	--

- | | |
|--|------|
| i) For metering service | - 1 |
| ii) For use with protective relays | - 5P |
| iii) For use with restricted earth fault and differential relays | - PS |

6.7.5 The C.T. cores for metering and protection shall be separate.

6.7.6 The ratio of C.T.s shall be as specified in Feeder details.

6.7.7 All the C.T.s shall be provided with terminals and shorting links. One of the terminals of the C.T. shall be earthed. The polarity of the C.T.s shall be clearly marked.

6.7.8 Provision of Interposing C.T.s is not acceptable.

6.7.9 The C.T.s shall be capable of withstanding momentary open circuit on the secondary side without injurious effects.

6.8 Voltage Transformers

6.8.1 The V.T.s shall be Class F insulated and vacuum impregnated or resin cast conforming to IS: 3156.

6.8.2 The primary nominal voltage shall be equal to the system nominal voltage. The secondary terminal voltage shall be 110 V.

6.8.3 The primary and secondary winding shall be protected by HRC fuses in each phase except in the ground phase of the secondary side.

6.8.4 The V.T.s shall be mounted on separate withdrawable carriage. The accuracy Class of V.T.s shall be 1.

6.8.5 The rated output of each V.T. shall be adequate for the relays, meters and associated wiring connected to it and shall not be less than 50 VA per phase.

6.9 Control Transformers

These shall be air cooled Class F insulated and vacuum impregnated. The rating of control transformer shall be twice the hold on VA of all contactor/relays or 2.5 KVA whichever is high. It shall be free from hum and rigidly mounted. Epoxy cast transformers shall be preferred.

6.10 Transformers for Kondorffer Starting

These shall be three phase core type, Class F insulated and vacuum impregnated. Tapping at 90%, 80%, 70% & 60% shall be provided and terminals shall be brought out for easy change of tapping at site. The operating temperature shall not exceed 80°C. The transformers shall be suitable for taking 7.5 times the specified full load current of the motor continuously for 120 secs.

6.11 Relays

6.11.1 All protective relays shall be of latest version, microprocessor based numerical type with communication port and interlinked with online energy management system. 100% redundancy shall be provided for communication.

6.12 Timers

The timers shall be electronic pneumatic or synchronous type with manual/auto reset

features as per the functional requirements. The time delay shall be 'ON' delay or 'OFF' delay type as specified. The repeat accuracy shall be 0.5% or better.

6.13 **Single Phasing Preventor**

6.13.1 Single phasing preventor relay shall be of the current operated type, suitable for the system voltage. The relay shall not operate for normal system voltage but operate positively in the event of unbalanced voltage more than the normal. The relay shall not operate in case of total interruption of power.

6.13.2 The relay shall be fail safe, self reset type and provided with flag indication. The relay operation shall be independent of the motor rating, loading and speed.

6.14 **Instruments and Meters**

6.14.1 All instruments shall be flush mounting type with square face of 96 mm x 96 mm. They shall be tropicalized and dust tight.

6.14.2 Meters shall be digital multifunctional meters with communication port for energy management at remote location.

6.14.3 All ammeters and voltmeters, to be provided separately, shall have 0-90° scale and shall be moving iron spring controlled type of class 1.5 accuracy as per IS: 1248. The scale range of the ammeters and voltmeters shall be as indicated in the Feeder details.

6.14.4 In case of motor feeders, the ammeters shall be graduated uniformly upto C.T. primary current and with compressed end scale upto 6 times C.T. primary current. Red pointer shall be provided, which shall be adjusted at site for indicating full load current of the motor.

6.15 **Push Buttons and Control Switches**

6.15.1 The switches and push buttons shall conform to utilization category AC11/DC11 as per IS: 60947. The contact shall be rated to make, break and carry inductive current of 5 Amp at 415 V AC and 1 Amp at 220 V DC.

6.15.2 The control switches shall be spring return rotary type, unless otherwise specified and provided with pistol grip type handle. The control switches for circuit breakers shall be additionally fitted with lost motion devices and sequencing devices.

6.15.3 The selector switches shall be stay put rotary type and provided with oval shape handles.

6.15.4 The push buttons shall be of momentary contact spring loaded type with a set of normally close and open contacts. The push button for 'Start' shall be shrouded type and coloured green, stop push button shall be un-shrouded type and coloured red and other push buttons shall be un-shrouded type coloured black. The fixing ring shall be metallic white.

6.15.5 Emergency stop push buttons, if specified, shall be lockable in pushed position.

6.16 **Miniature Circuit Breakers**

6.16.1 The miniature circuit breakers shall conform to IS: 8828 and shall be of duty category M-9.

6.16.2 It shall be provided with overload and short circuit protective devices in a heat resistant housing.

6.16.3 A certificate for short circuit rating and Current-Time tripping curve shall be furnished along with the offer.

6.17 **Signal Lamps**

6.17.1 Signal lamps shall be provided to indicate the various circuit conditions as shown in scheme drawings. The colour of the lamps for various functions shall be as follows :



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- Red -- Circuit breaker/switch/contactor closed.
- Green -- Circuit breaker/switch/contactor open.
- White -- Trip circuit healthy.
- Amber -- Alarm and auto trip.
- Blue -- Non-Trip

6.17.2 All lamps shall be of LED type with lumen output of 200 mili candela in axial direction.

7.0 ACCESSORIES

7.1 The supply shall include the following accessories:

- Maintenance truck/device for raising, lowering and withdrawal of circuit breaker, if required.
- Fuse puller.
- Test plug for relays.
- Test plug for kWh meters.

7.2 Space Heater

Each vertical section shall be provided with a thermostatically controlled space heater, rated for 240 V, 50 Hz and controlled through double pole miniature circuit breaker.

7.3 Name Plates

7.3.1 The switchboard shall have large name plate on the top indicating its Name, Designation and Code No.

7.3.2 Each feeder shall be provided with name plate. Each single front panel shall have name plate indicating panel number both in front and back.

7.3.3 All control switches, push buttons, lamps etc. shall have functional identification labels.

7.3.4 Name plate shall be of black Perspex with white engraving and of minimum 3mm thick.

7.4 Any other accessories required, but not specified, shall also be supplied to make the switchboard complete in all respects and ensure safe and proper operation.

8.0 PAINTING

8.1 The enclosure, after degreasing, pickling in acid, cold rinsing, phosphatising, passivating etc. shall be painted with two coats of anti-rust paint followed by two coats of anticorrosive paint.

8.2 Epoxy based paint shall be used.

8.3 All paints shall be carefully selected to withstand tropical heat and extremes of weather. The paint shall not scale off, crinkle or be removed by abrasion due to normal handling.

8.4 Unless otherwise specified, the finishing shade shall be light grey having Shade No.631 as per IS: 5.

8.5 One litre of paint shall be supplied along with each board for touch up at site.

9.0 TESTS AND INSPECTION

9.1 All the switchboards shall be subjected to routine test as per IS: 8623 and their components as per relevant standards.

9.2 Additional tests, wherever specified, shall be carried out.

- 9.3 All the above tests shall be carried out in presence of Purchaser's representative. In addition, the equipment shall be subjected to stage inspection during process of manufacture at works and site inspection.
- 9.4 These inspections shall however, not absolve the vendor from their responsibility for making good any defect which may be noticed subsequently.
- 10.0 DRAWINGS AND DOCUMENTS**
- 10.1 Drawings and documents as per Annexure-I shall be supplied, unless otherwise specified.
- 10.2 All drawings and documents shall have the following description written boldly:
- Name of Client
 - Name of Consultant
 - Enquiry / Order Number with Project / Plant Name
 - Code No. & Description
- 11.0 SPARES**
- 11.1 Commissioning Spares : Commissioning spares, as required, shall be supplied with the main equipment. Item-wise list of recommended commissioning spares shall be furnished for information.
- 11.2 Spares for 2 Years Operation (Mandatory), as specified shall be supplied.
- 11.3 List of Recommend Spares (other than Mandatory Spares) alongwith recommended quantity shall be furnished.
- 11.4 All spare parts shall be identical to the parts used in the equipment
- 12.0 PACKING**
- 12.1 The board shall be properly packed before despatch to avoid damage during transport, storage and handling.
- 12.2 The packing box shall contain a copy of the installation, operation and maintenance manual.
- 12.3 A sign to indicate the upright position of the panels to be placed during transport and storage shall be clearly marked. Also proper arrangement shall be provided to handle the equipment.

ANNEXURE - I

DOCUMENTATION FOR MEDIUM VOLTAGE SWITCHBOARDS

SI.No.	Documentation Description	Documents Required (Y / N)		
		With Bid	For Approval	Final
1.	Specification Sheets	N	Y	Y
2.	Technical Particulars	N	Y	Y
3.	Feeder Details	N	Y	Y
4.	General arrangement and Foundation Drgs.	N	Y	Y
5.	Schematic and Wiring Diagrams	N	Y	Y
6.	Calculation for Bus-bar sizing	N	Y	N
7.	Terminal Arrangement Drgs.	N	Y	Y
8.	Illustrative and Descriptive Literature	N	N	Y
9.	Catalogues for bought out accessories.	N	N	Y
10.	Installation, Operation and maintenance manual.	N	N	Y
11.	Test Certificates			
	i) Type -- Switchboard	N	N	N
	-- Circuit Breaker	N	N	N
	-- MCCB's	N	N	N
	ii) Routine	N	N	Y
12.	Guarantee Certificates	N	N	Y
13.	Spare Parts List	N	N	Y

Note:

1. 4 hard copies & 1 soft copy shall be supplied for approval after order within 4 weeks from the date of LOI.
2. 8 hard copies & 2 soft copies in CD shall be submitted as final documents prior to despatch of the equipment. These shall be made in sets and supplied in fine plastic coated folder.

Y - Yes, N – No



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6.0	COMPONENT DETAILS
7.0	ACCESSORIES
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9.0	TESTS AND INSPECTION
10.0	DRAWINGS AND DOCUMENTS
11.0	SPARES
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ANNEXURE - I	DOCUMENTATION FOR HIGH VOLTAGE SWITCHBOARDS

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1.0 SCOPE

1.1 This standard covers the technical requirements of design, manufacture, testing at works and delivery in well-packed condition of High Voltage Switch Boards.

1.2 This standard shall be read in conjunction with relevant part of Design Philosophy – Electrical , Schematic diagrams etc.

2.0 STANDARDS TO BE FOLLOWED

2.1 The design, manufacture and testing of the equipment shall comply with the latest issues of the following standard, unless otherwise specified. Equipment complying with equivalent IEC standards shall also be acceptable.

IS: 3427 A.C. Metal enclosed switchgear and control gear for rated voltages above 1 kV up to and including 52 kV.

IS: 13118 Specification for high voltage alternating current circuit breakers.

IS: 5578 Guide for marking of insulated conductors.

IS: 11353 Guide for uniform system of marking and identification of conductors and apparatus terminals.

IS: 10118 Code of Practice for selection, installation and maintenance of switchgear and control gear.

Various components housed in the switchboards shall conform to the Indian Standards Specification as mentioned against the component details or IEC Specifications.

2.2 The design and operational features of all the equipment offered shall also comply with the provisions of the latest issue of the Indian Electricity Rules and other Statutory Acts and Regulations. The supplier shall, wherever necessary, make suitable modifications in the equipment to comply with the above.

2.3 Wherever any requirement, laid down in this standard, differs from that in Indian Standard Specifications / IEC Specification, the requirement specified herein shall prevail.

3.0 SERVICE CONDITIONS

3.1 Ambient Conditions

These shall be as indicated in Design Philosophy – Electrical.

3.2 System Details

These shall be as indicated in Design Philosophy – Electrical.

4.0 OPERATING REQUIREMENTS

The switchboards shall be suitable for operating at the specified rating continuously, with the specified voltage and frequency variations under the ambient conditions, without exceeding the permissible temperature rise and without any detrimental effect on any part.

5.0 DESIGN AND CONSTRUCTIONAL FEATURES



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5.1 General

- 5.1.1 The switchboards shall consist of an assembly of a series of floor mounting, identical, metal clad, cubicle type panels placed side by side to form a compact assembly and shall be extensible on either side.
- 5.1.2 The complete assembly shall be dust, damp and vermin proof having minimum degree of protection equivalent to IP4X as per IS/IEC:60529. However, in case some ventilation openings are to be provided, these may be permitted for equipment located indoors and such openings shall be covered by fine wire mesh ensuring minimum IP3X protection.
- 5.1.3 The framework of the cubicles shall be bolted / welded construction. The minimum thickness of sheet steel shall be 3 mm for base channel and 2 mm for other members. The doors and covers shall be fabricated from cold rolled sheet steel. Suitable reinforcement, wherever necessary, shall be provided.
- 5.1.4 The switchboard shall be mounted on the channel which shall be included in the vendor's scope.
- 5.1.5 Each cubicle shall be provided with front access door with handle lock and key for breaker compartment and a removable back cover. The door hinges shall be concealed type. Front doors of the panels shall mechanically stop in full open position to facilitate removal of breakers and for ease of maintenance.
- 5.1.6 All external hardwares shall be cadmium plated. The hardwares for fixing removable parts shall be provided with retaining devices.
- 5.1.7 The doors and the removable covers shall be provided with non-deteriorating neoprene gaskets. Gaskets without any discontinuity shall be preferred. Gaskets shall be held in position in groove, in shaped sheet steel work or these shall be U-type.
- 5.1.8 Each cubicle shall have separate compartment within the cubicle for circuit breaker, bus-bars, instrument transformers, metering and relaying devices and cable termination.
- 5.1.9 Inter-panel and inter-compartment fire resistant barrier shall be provided. Cast resin seal off bushing shall be provided in the bus compartment, through which connections to breaker compartment/cable compartment/bus compartment of adjacent panel shall be taken. Failure of one of the equipment shall not effect the equipment in the adjacent compartment.
- 5.1.10 All the components shall be accessible for inspection and maintenance without the necessity of removing the adjacent ones. Their mounting shall be accessible and ensure the necessary degree of safety.
- 5.1.11 The layout of the components inside the cubicle shall be liberal to facilitate maintenance and the interconnecting wiring between components shall not be subjected to undue stresses at the bends.
- 5.1.12 Mounting height of components requiring operation and maintenance shall not be lower than 300 mm and higher than 1800 mm.
- 5.1.13 All live parts which are accessible after opening of front and back door/cover shall be properly insulated or provided with insulating barrier to prevent accidental contact. Phase insulating barriers shall be provided between the breaker poles. Removal facility shall be provided for all such barriers.
- 5.1.14 Adequate arrangement for earthing shall be provided to safeguard the operator or other personnel from electric hazards under all conditions of operation.
- 5.1.15 The switchboard shall be provided with following interlocks and safety features:
- i) The withdrawal and engagement of a circuit breaker shall not be possible unless it is in open position.



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- ii) The operation of a circuit breaker shall not be possible unless it is in fully service, test or isolated position.
- iii) It shall not be possible to close the circuit breaker in service position unless all auxiliary and control circuits are connected.
- iv) A breaker of the lower rating shall be prevented from engaging with the stationary element of higher rating.
- v) Insertion of the manual mechanism shall render the motorized mechanism inoperable.
- vi) Circuit breaker "ON", "OFF" indication shall be provided at the back of each panel.
- vii) Caution name plate shall be provided at the back of incomer panels where terminals are likely to remain live and isolation is possible only from remote end.
- viii) Automatic safety shutter, with padlocking facility for locking in closed position, to completely cover the spouts for bus-bars and cable connection when the breaker is withdrawn.

5.2 Bus-Bars and Connections

- 5.2.1 The bus-bars shall be for three phases. The bus-bars and connection shall be made of electrolytic grade copper of rectangular cross-section.
- 5.2.2 Bus-bars and connections shall be sleeved to protect against approach to live parts and to eliminate potential arcing points. Sleeving material shall have adequate electrical, thermal and mechanical properties to withstand impulse level, temperature rise during normal and short circuit condition and allow easy bending of bus bars.
- 5.2.3 The bus-bars shall be amply sized to carry the rated continuous current under the specified ambient temperature without exceeding the limits specified in IS: 8084. The thermal rating of the bus-bars shall be designed to withstand the system fault current for 3 seconds without exceeding the limiting temperature of 250°C for bare copper. Calculation for bus-bar sizing shall be furnished along with the offer.
- 5.2.4 Horizontal bus-bars shall run in a separate compartment through the entire length of the board and shall be of same cross-section throughout. Stepped bus-bars shall not be acceptable.
- 5.2.5 The bus-bars shall be arranged and colour coded according to IS: 5578 & IS: 11353.
- 5.2.6 The bus-bars chamber shall be sufficiently spacious and shall have separate screwed covers for maintenance purpose. It shall be adequately ventilated and shall allow the escape of the hot gases.
- 5.2.7 The bus-bars shall be rigidly supported at equal intervals to withstand the stresses due to full short circuit and also to take care of thermal expansion.
- 5.2.8 A minimum of two bolts shall be used per bus-bar joint. Only high tensile electro galvanized cadmium plated bolts, nuts and washers shall be used. The washers shall be spring and plain type. The bus-bar supports shall be of molded construction with built-in anti-tracking barriers. The support materials shall be of DMC or fiber glass reinforced thermosetting plastic.
- 5.2.9 The bus-bars, both horizontal and vertical, shall be PVC sleeved. Insulating shrouds shall be provided for all joints of insulated bus-bars.

5.3 Earth Bus

A continuous earth bus of Aluminium running along the lower part of the switchboard shall be provided with two end terminals with lugs for external connection. The earth bus shall be rated to carry three phase fault current for a period of 3 sec.

5.4 Bus Duct

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- 5.4.1 Suitable extension of bus-bars in proper phase sequence on the top, with connecting bolts shall be provided where connections between transformer and switchboard or between two halves of the switchboard is specified to be through bus duct.
- 5.4.2 Bus duct between two halves of the switchboard, if required, shall be supplied by the switchboard manufacturer. The bus-bars of interconnecting bus duct shall be similar to the main bus-bars of switchboard as specified above and shall conform to IS: 8084.
- 5.4.3 Bus duct between transformer and switchboard, if included in vendor's scope shall conform to IS: 8084.
- 5.5 **Clearances and Creepage Distance**
- The clearance and creepage distance shall be adequate to meet the BIL of the equipment.
- 5.6 **Insulation**
- 5.6.1 The insulation used shall be non-hygroscopic and shall be of porcelain, epoxy resins or fiber glass molded with plastic. It shall be of adequate electrical, mechanical and thermal strength to give trouble free service during normal operation and short circuit conditions.
- 5.6.2 The insulation shall be treated suitably to withstand the tropical conditions and atmospheric pollution.
- 5.7 **Control Wiring**
- 5.7.1 The switchboard shall be completely factory wired and ready for external connections.
- 5.7.2 The wiring shall be complete in all respect so as to ensure proper functioning of control, interlocking, protection, metering, indications and annunciations.
- 5.7.3 The wiring shall be carried out with flexible stranded PVC insulated copper conductor cables of 1100 Volt grade. The minimum size of wires shall be as follows:
- | | | |
|---------------------------|----|------------|
| C.T. Circuit | -- | 2.5 Sq. mm |
| V.T. and Control Circuits | -- | 1.5 Sq. mm |
- 5.7.4 All wiring shall be provided with dependent both ends marking as per IS: 5578. Numbered ferrules, reading from the terminal outwards, shall be provided at both ends of all wiring for easy identification. These shall be interlocking type plastic ferrules.
- 5.7.5 Control wiring circuits, fed from a supply common to a number of panels, shall be so protected that failure of a circuit in one panel does not affect the operation of other panels.
- 5.7.6 The wiring to the equipment mounted on the doors shall be carried out with flexible multi-strand copper conductor cable and so supported that on opening of the door, there is no undue strain on wire leads.
- 5.7.7 The control cables shall be neatly arranged and properly supported.
- 5.8 **External Cable Termination**
- 5.8.1 All power and control cables shall enter the switchboard from the bottom on the back of the panel. Sufficient space shall be provided for ease of connection and termination of cables.
- 5.8.2 All power cables and control cables shall be of type, number and size as indicated in Feeder Details.
- 5.8.3 The termination arrangement for single core cables shall be such that so as to minimize flow of eddy current and heating due to eddy currents.
- 5.8.4 Heavy duty double compression type rolled Aluminium cable glands along with the



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cable lugs, as required shall be provided for termination of control cables and auxiliary power supply cables.

- 5.8.5 The cable glands shall be mounted on a removable gland plate, provided at a minimum height of 75 mm from the bottom of the switchboard. Two number spare knockouts of size 20 mm shall also be provided on the gland plate for future use.
- 5.8.6 Terminal blocks shall be provided at suitable locations inside the panels for termination of control and auxiliary power supply wiring. These terminal blocks shall be pressure clamp type up to 35 sq. mm cables and bolted lug type for higher sizes of cables. These shall be protected type and rated for 1100 Volt service. The minimum current rating of the terminal block shall be 16 Amp.
- 5.8.7 Where more than two cables in parallel are required to be terminated, a system of bus links shall be provided with adequate clearance and spacing.
- 5.8.8 The terminal block shall be grouped according to circuit functions and numbered suitably. 20% extra terminals shall be provided in the terminal block.
- 5.8.9 Suitable clamps to support the vertical run of cables shall be provided.
- 5.8.10 For power connections, suitable marking on the terminals shall be provided to identify the phases.

5.9 Feeder Details

- 5.9.1 The requirements of incomer, bus coupler and outgoing feeders shall be as indicated in the single line diagram, feeder details and corresponding schematic diagrams.
- 5.9.2 Non-paralleling interlocks shall be provided between incomers and bus section panels. The interlocks shall be either electrical or mechanical type. Arrangement for defeating the interlock shall also be provided.
- 5.9.3 Auto changeover scheme, wherever specified, shall be provided.

5.10 Dummy Panels

Dummy panels complete with bus-bar system in 400 mm width shall be required for which unit price shall be indicated.

5.11 Control Power Supply

- 5.11.1 D.C. power required for closing, tripping and indication shall be supplied at the bus coupler panel through two completely separate circuits by the owner, one for tripping and another for closing and indication for the whole board.
- 5.11.2 For receiving each external control power supply, a double pole miniature circuit breaker shall be provided. This power shall be distributed inside the switchboard for each feeder having its MCB unit.

5.12 Space Heater Power Supply

- 5.12.1 Panel space heaters shall be fed from a separate bus, common for the whole board. This bus shall be fed from owner's supply for which a double pole MCB shall be provided in bus section panel.
- 5.12.2 Power supply for space heaters of motors shall be tapped from this bus by means of miniature circuit breakers located in the motor feeder panels. These MCB's shall be of triple pole and rated for 15 Amp.

6.0 COMPONENT DETAILS

Makes of all components shall be subject to owner's / consultant's approval



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- 6.1 **Circuit Breakers**
- 6.1.1 The circuit breakers shall comply with the requirements of IS: 13118.
- 6.1.2 All circuit breakers shall be of 0-3 min-CO-3 min-CO rated operating sequence capable of carrying the specified current at the site conditions and making/breaking of the system fault current.
- 6.1.3 Type test certificates from an independent testing authority shall be furnished along with the offer for each circuit breaker rating and type.
- 6.1.4 The circuit breakers controlling motors shall be suitable for DOL starting and stopping induction motor a number of times and shall have provision to limit over voltage to the value safe for motor insulation. Unless otherwise specified this value shall be taken as 2.5 times the rated voltage. The magnitude of the voltage surge produced by the breaker when switching off the smallest motor shall be indicated.
- 6.1.5 The circuit breakers controlling capacitors shall be suitable for energizing and de-energizing the rated capacitor bank.
- 6.1.6 The circuit breakers shall be of the 3 phase, single/double break, horizontal draw-out, vertical/horizontal isolation type. The medium of arc quenching shall be minimum Oil/Bulk oil/vacuum/SF6 as specified elsewhere.
- 6.1.7 The circuit breakers shall be suitable for electrical/manual closing as specified in Feeder details. Electrically operated circuit breakers shall preferably have motor wound spring closing mechanism with provision for manual closing arrangement. Manually operated circuit breakers shall have independent manual spring closing mechanism. In all cases tripping shall be by means of shunt trip coil.
- 6.1.8 All circuit breaker units of the same rating shall be physically and electrically interchangeable.
- 6.1.9 The circuit breakers shall be electrically and mechanically trip free and provided with anti-pumping feature.
- 6.1.10 The circuit breakers shall have three positions, i.e. service, test and isolated with the cubicle door closed. Necessary stoppers shall be provided to prevent the excessive movement of the breaker cradle than desired for the position. Service and test positions of the breaker shall have monitoring switch having 1NO+1NC contacts.
- 6.1.11 The circuit breakers shall be provided with emergency manual trip device, mechanical 'ON', 'OFF', 'ISOLATED' position and spring 'CHARGED', 'DISCHARGED' indicators and operation counter.
- 6.1.12 A maintenance truck/device, if required, for raising, lowering and withdrawals of the circuit breaker shall be supplied for each switchboard.
- 6.1.13 The arc interrupting devices shall be capable of interrupting satisfactorily current from zero to the rated interrupting current when used on predominantly capacitive or inductive circuits, without requiring excessive maintenance of the contacts. The arc shall be restricted within the interrupting chamber and no emission of flame shall be allowed which may cause electrical breakdown or damage to insulation on the apparatus.
- 6.1.14 Mechanical safety interlock shall be provided for safe operating and movement of the breaker.
- 6.1.15 The circuit breakers shall be provided with minimum of four normally open and four normally closed auxiliary switch contacts, over and above those required for its own control scheme, for owner's use. These contacts shall be wired separately to the terminal board.
- 6.1.16 The closing coil and other associated auxiliary relays shall operate satisfactorily at all



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voltages between 85% and 110% of the rated control voltage. The tripping coil and other associated relays shall operate satisfactorily at all voltages between 70% and 110% of the rated control voltage.

6.1.17 Cable earthing facility shall be provided in the circuit breaker for discharging of power cable through the circuit breaker contact with circuit breaker in drawn-out position. An integral earthing arrangement shall be preferred. In case the integral earthing arrangement is not feasible due to circuit breaker design, a separate earthing truck, which shall be inserted in place of circuit breaker, shall be provided per board.

6.1.18 Positive earthing of circuit breaker frame shall be maintained at every position of circuit breaker. The earthing contact shall be line/scraping type and not of point type.

6.2 Current Transformers

6.2.1 The current transformers shall conform to IS: 2705.

6.2.2 C.T.s shall be class F insulated and vacuum impregnated or resin cast type. The C.T.s shall be rigidly mounted and shall be easily accessible for maintenance and testing.

6.2.3 The short time thermal withstand ratings of the C.T.s shall be same as the thermal withstand ratings of the breakers.

6.2.4 The C.T.s output shall be minimum 15 VA per phase and in any case, the output shall be adequate for the protection and metering duties involved with sufficient margin. The C.T.s shall have the following accuracies for the various applications:

<u>Application</u>	<u>Class of Accuracy as per IS: 2705</u>
i) For metering service	1
ii) For use with protective relays	5 P
iii) For use with restricted earth fault and differential relays	PS

6.2.5 The C.T. cores for metering and protection shall be separate.

6.2.6 The ratios of the current transformers shall be as indicated in Feeder details.

6.2.7 All the C.T.s shall be provided with terminals and shorting links. One of the terminals of the C.T. shall be earthed. The polarity of the C.T. shall be clearly marked.

6.2.8 Provision of interposing C.T. is not acceptable.

6.2.9 The C.T.s shall be capable of withstanding momentary open-circuit on the secondary side without injurious effects.

6.3 Voltage Transformers

6.3.1 The V.T.s shall be class F insulated and vacuum impregnated or resin cast type conforming to IS: 3156.

6.3.2 The primary nominal voltage shall be equal to the system nominal voltage. The secondary terminal voltage shall be $110 / \sqrt{3}$ V.

6.3.3 The rated output of each VT shall be adequate for the relays, meters and associated wiring connected to it with sufficient margin and shall not be less than 200 VA per phase.

6.3.4 The accuracy class of V.T.s shall be 1 as per IS: 3156.

6.3.5 The primary and secondary winding shall be protected by HRC fuses in each phase except in the grounded phase of the secondary side.

6.3.6 The V.T. shall be mounted on a with-drawable carriage. Shutters with padlocking facility, provided on high voltage sides, shall be so arranged that the live orifices are



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automatically closed when the V.T. is withdrawn.

6.3.7 Mechanical interlocking arrangement shall be provided so that the access to the high voltage fuse is possible only when the V.T. is fully withdrawn.

6.4 Relays

6.4.1 All protective relays shall be of latest version, microprocessor based numerical type with communication port and interlinked with online energy management system. 100% redundancy shall be provided for communication.

6.5 Timers

6.5.1 The timers shall be electronic, pneumatic or synchronous type with manual/ auto reset features as per the functional requirements. The timers shall be 'ON' delay or 'OFF' delay type as specified. The repeat accuracy shall be 0.5% or better.

6.6 Instruments and Meters

6.6.1 All instruments shall be flush mounting type with square face of 96 mm x 96 mm. They shall be tropicalized and dust tight.

6.6.2 Meters shall be digital multifunctional meters with communication port for energy management at remote location.

6.6.3 All ammeters and voltmeters, to be provided separately, shall have 0-90° scale and shall be moving iron spring controlled type of class 1.5 accuracy as per IS: 1248. The scale range of the ammeters and voltmeters shall be as indicated in the Feeder details.

6.6.4 In case of motor feeders, the ammeters shall be graduated uniformly upto C.T. primary current and with compressed end scale upto 6 times C.T. primary current. Red pointer shall be provided, which shall be adjusted at site for indicating full load current of the motor.

6.7 Push Buttons and Control Switches

6.7.1 The switches and push buttons shall conform to utilization category AC11/DC11 as per IS/IEC:60947. The contact shall be rated to make, break and carry inductive current of 5 Amps. at 415 V AC and 1 Amp. at 220 V DC.

6.7.2 The control switches shall be spring return rotary type, unless otherwise specified and provided with Pistol grip type handle. The control switches for circuit breakers shall be additionally fitted with lost motion devices and sequencing devices, if required.

6.7.3 The selector switches shall be stay put rotary type and provided with oval shape handles.

6.7.4 The push buttons shall be of momentary contact spring loaded type with a set of normally close and open contacts. The start push button shall be shrouded type and coloured green. The stop push button shall be un-shrouded type and coloured red and other push buttons shall be un-shrouded type and coloured black. The fixing ring shall be metallic white.

6.7.5 Emergency stop push buttons, if specified, shall be lockable in pushed position.

6.8 Control Fuses

6.8.1 The fuses shall be non-deteriorating HRC cartridge link type and shall conform to IS: 13703. They shall be suitable for load and service required in the circuit.

6.8.2 One fuse puller shall be supplied along with each board.

6.9 Miniature Circuit Breakers

6.9.1 The miniature circuit breakers shall conform to IS: 8828 and shall be of duty category M-9.

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6.9.2 It shall be provided with overload and short circuit protective devices in a heat resistant housing.

6.9.3 Type test certificate for short circuit rating and current time tripping curve shall be furnished along with the offer.

6.10 Signal Lamps

6.10.1 Signal lamps shall be provided to indicate the various circuit conditions as shown in scheme drawings. The colour of the lamps for various functions shall be as follow:

- | | | |
|-------|---|-----------------------|
| Red | - | Circuit breaker 'ON' |
| Green | - | Circuit breaker 'OFF' |
| White | - | Trip circuit healthy |
| Amber | - | Alarm and auto trip |
| Blue | - | Non-Trip |

6.10.2 The lamps shall LED type with lumen output of 200 millicandella in axial direction.

7.0 ACCESSORIES

7.1 The supply shall include the following accessories.

- Maintenance truck/device for raising, lowering and withdrawal of circuit breaker, if required.
- Earthing truck, in case the integral earthing arrangement is not feasible in the circuit breaker.
- Fuse puller.
- Test plug for relays.
- Test plug for kWh meters.
- Special tools and tackles, as required.

7.2 Space Heater

7.2.1 Each panel shall be provided with a thermostatically controlled space heater, rated for 240 V, 50 Hz and controlled through double pole miniature circuit breaker.

7.3 Name Plates

7.3.1 The switchboard shall have large name plate on the top to indicate its name and designation.

7.3.2 Each panel shall be provided with name plate both in front and back.

7.3.3 All control switches, push buttons, lamps etc. shall have functional identification labels.

7.3.4 Name plate shall be of black Perspex with white engraving and of minimum 3 mm thick.


7.4 Any other accessories required, but not specified, shall also be supplied to make the switchboard complete in all respects and ensure safe and proper operation.

8.0 PAINTING

8.1 The enclosure, after degreasing, pickling in acid, cold rinsing, phosphatising, passivating etc. shall be painted with two coats of anti-rust paint followed by two coats of anti-corrosive paint.

8.2 Epoxy based paint shall be used.

8.3 All paints shall be carefully selected to withstand tropical heat and extremes of weather. The paint shall not scale off, crinkle or be removed by abrasion due to normal handling.

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8.4 Unless otherwise specified, the finishing shade shall be light grey having shade No.631 as per IS: 5.

8.5 One litre of paint shall be supplied along with each board for touch up at site.

9.0 TESTS AND INSPECTION

9.1 All the switchboards shall be subjected to routine test as per IS: 3427 and their components as per relevant standards.

9.2 Additional tests, wherever specified, shall be carried out.

9.3 All the above tests shall be carried out in presence of purchaser's representative. In addition, the equipment shall be subjected to stage inspection during process of manufacture at works and site inspection.

9.4 These inspection shall, however, not absolve the vendor from his responsibility for making good any defect which shall be noticed subsequently.

10.0 DRAWINGS AND DOCUMENTS

10.1 Drawings and documents as per Annexure-I shall be supplied, unless otherwise specified.

10.2 All drawings and documents shall have the following description written boldly.

- Name of client
- Name of consultant
- Enquiry / Order Number with plant / project name
- Code No. and Description

11.0 SPARES

11.1 Commissioning Spares : Commissioning spares, as required, shall be supplied with the main equipment. Item-wise list of recommended commissioning spares shall be furnished for information.

11.2 Spares for 2 Years Operation (Mandatory), as specified shall be supplied.

11.3 List of Recommend Spares (other than Mandatory Spares) alongwith recommended quantity shall be furnished.

11.4 All spare parts shall be identical to the parts used in the equipment.

12.0 PACKING

12.1 The switchboard shall be properly packed before dispatch to avoid damage during transport, storage and handling.

12.2 The packing box shall contain a copy of the installation, operation and maintenance manual.

12.3 A sign to indicate the upright position of the panels to be placed during transport and storage shall be clearly marked. Also proper arrangement shall be provided to handle the equipment.



ANNEXURE - I
DOCUMENTATION FOR HIGH VOLTAGE SWITCHBOARDS

Sl. No.	Description	Documents Required (Y / N)		
		With Bid	For Approval	Final
1.	Specification Sheets	N	Y	Y
2.	Technical Particulars	N	Y	Y
3.	Feeder Details	N	Y	Y
4.	General arrangement and Foundation Drawings	N	Y	Y
5.	Schematic/Wiring Diagrams	N	Y	Y
6.	Calculation for Bus-bar sizing	N	Y	N
7.	Terminal Arrangement Drawings	N	Y	Y
8.	Illustrative and Descriptive Literature	N	N	Y
9.	Catalogues for bought out accessories	N	N	Y
10.	Installation, Operation and maintenance manual	N	N	Y
11.	Test Certificates			
	i) Type - Switchboard	N	N	N
	- Circuit Breaker	N	N	N
	- MCB	N	N	N
	ii) Routine	N	N	Y
12.	Guarantee Certificates	N	N	Y
13.	Spare Parts List	N	N	Y

Note:

1. 4 hard copies & 1 soft copy shall be supplied for approval after order within 4 weeks from the date of LOI.
 2. 8 hard copies & 2 soft copies in CD shall be submitted as final documents prior to despatch of the equipment. These shall be made in sets and supplied in fine plastic coated folder.
- Y - Yes, N – No



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TECHNICAL SPECIFICATION

BUS DUCT



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2.0	STANDARDS TO BE FOLLOWED
3.0	SERVICE CONDITIONS
4.0	OPERATING REQUIREMENTS
5.0	GENERAL DESIGN AND CONSTRUCTIONAL FEATURES
6.0	ACCESSORIES
7.0	LAYOUT
8.0	PAINTING
9.0	TESTS AND INSPECTION
10.0	DRAWINGS AND DOCUMENTS
11.0	SPARES
12.0	PACKING
ANNEXURE - I	DOCUMENTATION FOR BUS DUCT

1.0 SCOPE

- 1.1 This standard covers the technical requirements of design, manufacture testing at works and despatch in well packed condition of bus duct.
- 1.2 This standard shall be read in conjunction with relevant part of Design Philosophy - Electrical.

2.0 STANDARDS TO BE FOLLOWED

- 2.1 The design, manufacture and testing of the equipment covered by this standard shall comply with the latest issue of following Indian Standards unless otherwise specified. Equipment complying with equivalent IEC standards shall also be acceptable.

- IS: 8084 - Interconnecting bus-bars for A.C. Voltage above 1 KV up to and including 36 KV.
- IS: 8623 - Specification for low voltage switchgear and control gear assemblies.
- IS: 5578 - Guide for marking of insulated conductors.
- IS: 11353 - Guide for uniform system of marking and identification of conductors and apparatus terminals.

- 2.2 The design and operational features of all the equipment offered shall also comply with the provisions of the latest issue of the Indian Electricity Rules and other relevant Statutory Acts and Regulations. The supplier shall wherever necessary, make suitable modifications in the equipment to comply with the above.

- 2.3 Wherever any requirement, laid down in this standard differs from those in Indian Standard Specifications, the requirement specified herein shall prevail.

3.0 SERVICE CONDITIONS

3.1 Ambient conditions

These shall be as indicated in Design Philosophy - Electrical.

3.2 System Details

These shall be as indicated in Design Philosophy - Electrical.

4.0 OPERATING REQUIREMENTS

The bus duct shall be suitable for operating at the rated capacity continuously under the ambient conditions and with the voltage and frequency variations without exceeding the permissible temperature rise and without any detrimental effect on any part.

5.0 GENERAL DESIGN AND CONSTRUCTIONAL FEATURES

5.1 Enclosures

- 5.1.1 The sheet steel enclosure for enclosing and supporting the bus-bars shall be made out of 14 SWG sheet steel, bolted on the angle iron frame work.

- 5.1.2 The enclosure shall completely enclose the bus bars from all sides. It shall have degree of protection IP: 52 for indoor installation and IP: 55 with rain protection canopy for outdoor installation as per IS/IEC:60947. Where part of the bus duct is required for indoor installation and part for outdoor installation, the complete section shall be suitable for outdoor installation. Ventilation louvers, if necessary, shall be provided with fine wire mesh from inside, in that case the degree of protection shall be IP: 42. Neoprene gasket shall be provided on covers at joints.



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- 5.1.3 Whether bus duct (with louvers) is installed outdoor or indoor, suitably rated space heater with thermostat control shall be provided at different locations inside the bus duct to avoid moisture condensation.
- 5.1.4 All external hardware of diameter less than 8 mm shall be stainless steel and those of diameter 8 mm and above shall be mild steel cadmium plated or zinc passivated.
- 5.2 **Bus Bars and Connections**
- 5.2.1 The bus-bars in LV Bus duct shall be of three phase and neutral, non-segregated and air insulated type.
The bus-bars in HV Bus duct shall be of three phase, phase-segregated with insulating material.
- 5.2.2 The bus bars shall be amply sized to carry the rated continuous current under the specified ambient temperature without exceeding the temperature limits specified in IS: 8084. The bus bars shall be designed to withstand the system fault current for one second without exceeding the total temperature of 200°C. Type test certificate of similar bus duct shall be furnished.
- 5.2.3 The bus-bars material shall be high conductivity Aluminium alloy conforming to grade E91E of IS: 5082/electrolytic grade copper.
- 5.2.4 The bus-bars shall be rectangular in shape and cross-sectional area of neutral bus-bars shall be half of phase bus-bars.
- 5.2.5 The sizes of bus-bars selected shall be subjected to approval by PDIL. The vendor shall furnish supporting calculations for bus-bars and enclosure sizes both under normal load and short circuit conditions as well as that of temperature rise along with the offer.
- 5.2.6 All the bus-bars shall be bare and without any painting. The bus-bars shall be arranged and provided with proper phase identification as per IS: 5578/11353.
- 5.3 **Joints and Bends**
- 5.3.1 Only lap joints shall be used for jointing the bus bars. The over lap shall be equal to the width of the bus bars.
- 5.3.2 The contact surfaces of the overlapping bus-bars shall be thoroughly cleaned followed by application of good quality electrical grease and bolted immediately. In case of Aluminium to copper joints, copper bus-bars in addition shall be preferably tinned.
- 5.3.3 The bolting schedule adopted shall ensure proper contact pressure. A minimum of two bolts shall be used per joint.
- 5.3.4 The contact pressure shall be 100-140 kg/cm². Only high tensile, zinc passivated or galvanized steel bolts shall be used along with large diameter flat washers of adequate thickness.
- 5.3.5 At the bends, the bus-bars shall bend at a radius of 2t where the 't' is the thickness of the bus-bars and the radius is measured to the inside of bus-bars.
- 5.4 **Flexible Joints**
Flexible joints and connections shall consist of tinned laminated copper strips or Aluminium strips of required cross sectional area. Precautions as mentioned under 5.3.2 shall also be observed while marking joints with laminated copper plates. Filler plates of Aluminium as required shall be used.
- 5.5 **Expansion Joints**
Expansion joints, where necessary, to allow for longitudinal expansion and contraction of bus-bars and bus enclosures caused by temperature variation shall be provided.

5.6 Bus Bar Supports

5.6.1 The bus-bars shall be rigidly supported at equal intervals. The bus-bars supports shall be such that they withstand stresses to which they may be subjected under normal and short circuit conditions.

5.6.2 The supports shall be of moulded construction of fibre glass reinforced with thermosetting plastics or superior materials. The supports, where necessary, shall either have built-in anti-tracking barriers or painted with anti-tracking varnishes.

5.7 Clearances and Creepage Distance

5.7.1 The clearances and creepage distance shall not be lower than the values specified below for any part of the bus duct.

- | | | | |
|------|---|---|-------|
| i) | Minimum clearance between two live parts | - | 25 mm |
| ii) | Minimum clearance between a live part and accidentally dangerous part | - | 25 mm |
| iii) | Creepage distance | - | 30 mm |

5.7.2 The clearances and creepage distance, as specified above, shall definitely be maintained throughout the bus bars system. Provision of bus-bar separators or barriers shall not be considered to reduce the clearances from the values specified above.

5.8 Terminal Chambers at Switchgear and Transformer End

5.8.1 The bus duct shall be suitable for bolting to the flanges provided at the transformer and switchgear end. The exact dimensions and details of these terminal chambers shall be made available at the time of execution.

5.8.2 Phase changeover arrangement wherever required shall be provided in one of the terminal chambers to connect the bus-bars between same phase terminals at switchgear and transformer ends.

6.0 ACCESSORIES

6.1 Earthing

Two continuous earth strips of Aluminium having minimum 300 sq. mm size shall be provided throughout the length of bus duct or shall be suitable for full short circuit fault current for 1 sec. whichever is more.

6.2 Drain Plug

Bus duct shall be provided with drain plug to remove condensed moisture when required.

6.3 Fire Barriers

Two sets of epoxy moulded fire barriers shall be provided on switchgear end as well as transformer end.

6.4 Name Plates

6.4.1 Each bus duct shall be provided with a name plate of stainless steel with letter embossed on them and located at convenient location.

6.4.2 The name plate shall contain all details as per IS: 8084.

6.5 Hardware

Required number of hardwares like bolts, nuts, plain washers, spring washers etc. shall be provided for jointing the bus duct with transformer as well as switchgears.

7.0 LAYOUT

7.1 The proposed bus duct routing between transformer and associated switchgear shall be as shown in the drawing enclosed with NIT. Where no layout drawing is enclosed, the

schedule of quantities shall be followed for bidding. However, the exact routing and details of switchgear and transformer end chambers shall be supplied at the time of order or drawing approval.

- 7.2 The successful vendor shall prepare final layout drawing for each bus duct with bill of materials and submit the same for PDIL/Purchaser's approval.

8.0 PAINTING

- 8.1 The enclosure after degreasing, pickling in acid, rinsing, phosphatising, passivating etc. shall be painted with two coats of anti-rust paint followed by two coats of anticorrosive paint.

- 8.2 Epoxy based paint shall be used.

- 8.3 All paints shall be carefully selected to withstand tropical heat and extremes of weather. The paint shall not scale off, crinkle or be removed by abrasion due to normal handling.

- 8.4 Unless otherwise specified, the finishing shade shall be light grey having shade no. 631 as per IS: 5.

9.0 TESTS AND INSPECTION

- 9.1 The bus duct shall be subjected to routine tests as per relevant standard.

- 9.2 Wherever specified, temperature rise tests shall be carried out on a minimum 5 metre length bus duct of each rating.

- 9.3 The test shall be carried out in manufacturer's works in presence of purchaser's representative. In addition, the bus ducts shall be subjected to stage inspection at works and inspection at site for final acceptance.

- 9.4 These inspections shall, however, not absolve the vendor from his responsibility of making good any defect which may be noticed subsequently.

10.0 DRAWINGS AND DOCUMENTS

- 10.1 Drawings and documents as per Annexure - I shall be supplied, unless otherwise specified.

- 10.2 All drawings and documents shall have the following descriptions written boldly

- Name of client
- Name of consultant
- Enquiry / Order Number with plant / project name
- Code No. and Description

11.0 SPARES

- 11.1 Commissioning Spares : Commissioning spares, as required, shall be supplied with the main equipment. Item-wise list of recommended commissioning spares shall be furnished for information.

- 11.2 Spares for 2 Years Operation (Mandatory), as specified shall be supplied.

- 11.3 List of Recommend Spares (other than Mandatory Spares) alongwith recommended quantity shall be furnished.

- 11.4 All spare parts shall be identical to the parts used in the equipment.

12.0 PACKING

- 12.1 The bus duct shall be properly packed before despatch to avoid damage during transport, storage and handling. It shall be wrapped in polythene bags to make it



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waterproof. An additional wrapping with bitumen paper shall also be provided to make it completely water proof before the equipment is packed in wooden crates.

- 12.2 The packing box shall contain a copy of the installation, operation and maintenance manual.

ANNEXURE - I
DOCUMENTATION FOR BUS DUCT

Sl.No.	Description	Documents Required (Y / N)		
		With Bid	For Approval	Final
1.	General arrangement for each bus duct showing the complete layout.	N	Y	Y
2.	Design calculations	N	Y	N
	a) Bus bars sizing			
	b) Flexible sizing			
	c) Temperature Rise			
	d) Support Span			
3.	Specification sheet & Technical Particulars	N	Y	Y
4.	Switchgear end termination details for each rating of bus duct.	N	Y	Y
5.	Transformer end termination details for each rating of bus duct.	N	Y	Y
6.	Assembly drawing of rigid bends.	N	Y	Y
7.	Assembly drawing of bends with flexible	N	Y	Y
8.	Assembly drawing of straight run	N	Y	Y
9.	Transposition chamber details	N	Y	Y
10.	Installation, operation & maintenance manual	N	Y	Y
11.	Test Certificates			
	i) Type	N	N	N
	ii) Routine & others	N	N	Y
12.	Guarantee Certificates	N	N	Y
13.	List of spare parts	N	N	N

Note:

1. 4 hard copies & 1 soft copy shall be supplied for approval after order within 4 weeks from the date of LOI.
2. 8 hard copies & 2 soft copies in CD shall be submitted as final documents prior to despatch of the equipment. These shall be made in sets and supplied in fine plastic coated folder.

Y - Yes, N - No

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TECHNICAL SPECIFICATION

SHEET STEEL DISTRIBUTION BOARDS



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1.0 SCOPE

- 1.1 This standard covers the technical requirements of design, manufacture, testing at works and delivery in well-packed condition of Sheet Steel Distribution Boards.
- 1.2 This standard shall be read in conjunction with relevant part of Design Philosophy – Electrical.

2.0 STANDARDS TO BE FOLLOWED

- 2.1 The design, manufacture and testing of the equipment shall comply with the latest issue of the following Indian Standards, unless otherwise specified. Equipment complying with equivalent IEC standards shall also be acceptable.

- IS: 8623 - Specification for low voltage switchgear and control gear assemblies.
- IS/IEC:60947 - Specification for Low-voltage Switchgear and Control gear
- IS: 5578 - Guide for marking of insulated conductors.
- IS: 11353 - Guide for uniform system of marking and identification of conductors and apparatus terminals.
- IS: 10118 - Code of practice for selection, installation and maintenance of switchgear and control gear.

Various components housed in the distribution board shall conform to the Indian Standard Specification as mentioned against the component details.

- 2.2 The design and operational features of the equipment offered shall also comply with the provisions of the latest issue of the Indian Electricity Rules and other Statutory Acts and Regulations. The supplier shall, wherever necessary, make suitable modifications in the equipment to comply with the above.
- 2.3 Wherever any requirement, laid down in this standard, differs from that in Indian Standard Specification the requirement specified herein shall prevail.

3.0 SERVICE CONDITIONS

3.1 Ambient Conditions

These shall be as indicated in Design Philosophy – Electrical.

3.2 System Details

These shall be as indicated in Design Philosophy – Electrical.



4.0 OPERATING REQUIREMENTS

The distribution board shall be suitable for operating at the specified rating continuously with the specified voltage and frequency variations under the ambient conditions, without exceeding the permissible temperature rise and without any detrimental effect on any part.

5.0 DESIGN AND CONSTRUCTIONAL FEATURES

5.1 General

- 5.1.1 The distribution board shall consist of an assembly of a series of floor mounting, identical, metal clad, dead front type panels of unitized design. The panels shall be placed side by side to form a compact assembly and shall be extensible on either side.
- 5.1.2 The complete assembly shall be dust, damp and vermin proof having minimum degree of protection equivalent to IP-52 as per IS/IEC:60947.
- 5.1.3 The frame work of the cubicles shall be of bolted/welded construction. The minimum thickness of steel shall be 2 mm for load bearing members, 1.6 mm for non-load bearing

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members and 3 mm for base channel. The doors and covers shall be fabricated from cold rolled sheet steel. Suitable reinforcement, wherever necessary, shall be provided.



- 5.1.4 The door hinges shall be concealed type.
- 5.1.5 All external hardware shall be cadmium plated/zinc passivated. The hardware for fixing the removable parts shall be provided with retaining devices.
- 5.1.6 The doors and the removable covers shall be provided with non-deteriorating neoprene gaskets. Gaskets without any discontinuity shall be preferred. Gaskets shall be held in position in groove of shaped sheet steel work or these shall be of U type. Adhesive cement, if used, shall be of good quality so that the gaskets do not come off during service.
- 5.1.7 All the components shall be accessible for inspection and maintenance without the necessity for removal of the adjacent ones. In case of single front design all components shall be accessible from the front for maintenance and back opening doors/ openable covers for maintenance shall not be acceptable.
- 5.1.8 The layout of the components inside a module shall be liberal to facilitate maintenance and the interconnection of wiring between the components shall not be subjected to any undue stress at the bends.
- 5.1.9 Mounting height of components requiring operation and observation shall not be lower than 300 mm and higher than 1800 mm.
- 5.1.10 Inter panel barriers shall be provided.
- 5.1.11 Adequate arrangement for earthing shall be provided to safeguard the operator or other personnel from electric hazards under all conditions of operation.

5.2 Panel Arrangement

- 5.2.1 The distribution board shall be non-drawout type in single front configuration.
- 5.2.2 Each Panel shall have its horizontal bus-bar chamber running on the top with multi-tier module units in the centre and having vertical bus-bar chamber and cable alley on either side.
- 5.2.3 The modules shall be enclosed on all sides and shall be so arranged that larger ones are placed at the bottom portion of the panel. Fixed type modules shall be at least 300 mm from the base channel.
- 5.2.4 The number of modules in the panel shall not exceed six for motor starter feeders and eight for switch fuse/MCB/MCCB feeders. The minimum size of module shall be 300 mm and 200 mm for starter and switch fuse feeders. The incomer and bus coupler module sizes for ratings up to 400 A shall be half the panel size. For higher ratings they shall be housed in single panel.
- 5.2.5 The module door shall be so interlocked that it shall not be possible to open the door with switch in closed position. Defeat interlock facility shall be provided.
- 5.2.6 The relay, meters, switches and lamps shall be flush mounted. All components of one module shall be mounted on the same module on a rigid sheet steel chassis. A 20 mm dia. rotating knob on the door shall be provided for closing and opening.



5.3 Bus Bars and Connections

- 5.3.1 The bus-bar shall be suitable for the supply system. The bus-bar and connections shall be made of electrolytic copper or high conductivity aluminium alloy conforming to Grade E91E of IS: 5082.
- 5.3.2 The bus-bar shall be amply sized to carry the rated continuous current under the specified ambient temperature without exceeding the temperature of 90°C. The bus-bars shall also be designed to withstand the system fault current for 1 second without



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exceeding the temperature of 200°C for bare aluminium and 250°C for bare copper. The minimum acceptable size of bus-bars shall be 250 sq. mm (Al). Calculation for the bus-bar sizing shall be furnished along with the offer.

- 5.3.3 In case of double front arrangement of distribution boards, different sets of vertical bus-bars shall be provided. The vertical bus-bars shall be PVC sleeved or shrouded by insulating barriers which shall have cut-outs to permit entry of power wires. It shall be possible to remove the shroud for inspection and maintenance. Neutral-bars shall be provided in this chamber.
- 5.3.4 Horizontal bus-bars shall be of same cross-section through out. Stepped bus-bars shall not be acceptable.
- 5.3.5 All bus-bars shall be arranged and colours coded according to IS: 5578/11353.
- 5.3.6 The horizontal bus-bar shall run in a separate bus chamber located at the top shall have separate screwed cover for inspection purpose.
- 5.3.7 The bus-bars shall be rigidly supported at equal intervals to withstand maximum short circuit stresses. The supports shall be of moulded construction with built in anti tracking barriers. The support material shall be of fibre glass reinforced thermosetting plastic.
- 5.3.8 All joints shall be suitably treated to avoid oxidation of contact surfaces and bimetallic corrosion. A minimum of two bolts with spring washers shall be used for horizontal bus-bar joints.
- 5.3.9 Horizontal bus bars shall be insulated with heat shrinkable PVC sleeves of reputed makes. Insulating shrouds shall be provided for all joints of insulated bus-bars.
- 5.4 Clearance and Creepage Distances**
- 5.4.1 The clearance and creepage distances shall not be lower than the values specified below :
- | | | |
|---|----|-------|
| i) Minimum clearance between two live conductors | -- | 20 mm |
| ii) Minimum clearance between live part and accidentally dangerous part | -- | 20 mm |
| iii) Minimum creepage distance | -- | 28 mm |
- 5.4.2 The clearances and the creepage, as specified above, shall definitely be maintained in the bus-bar system. Provision of bus-bar insulations, separator or barriers shall not be considered to reduce the clearance from the values specified above.
- 5.4.3 At the termination points in the equipment, e.g. switches, contactors, thermal relays, etc. it is realized that above clearance shall not always be possible to be maintained. All such points where above clearance are not possible to be maintained shall, therefore, be insulated or taped.
- 5.5 Insulation**
- 5.5.1 The insulation used shall be non-hygroscopic and shall be of porcelain, Epoxy- resins or fibre glass moulded with plastic. It shall be of adequate electrical and mechanical strength to give trouble free service during normal operation and short circuit conditions.
- 5.5.2 The insulation shall be treated suitably to withstand the tropical conditions and atmospheric pollution.
- 5.6 Power Wiring**
- 5.6.1 The connections from bus-bar including neutral to individual units on the modules shall consist of PVC insulated flexible copper cable or tapped copper strip.

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- 5.6.2 The power wiring size shall be decided based on the rating of the switch, after using a rating factor of not more than 50% over the current rating in free air. In any case the minimum size of power wiring shall not be less than 4 sq. mm copper.
- 5.6.3 The size of connection from incomer to horizontal bus-bar and from horizontal bus-bar to bus coupler shall not be less than the size adopted for horizontal bus-bar.
- 5.7 Control Wiring**
- 5.7.1 The switch board shall be completely factory wired and ready for external connections.
- 5.7.2 The wiring shall be carried out with flexible stranded PVC insulated copper conductor cables of 1100 Volt grade. The size of wires shall be as follows:
- | | | |
|---------------------------|----|------------|
| C.T. Circuit | -- | 2.5 sq. mm |
| V.T. and Control Circuits | -- | 1.5 sq. mm |
- 5.7.3 All wiring shall be provided with dependent both end marking as per IS: 5578. Numbered ferrules, reading from the terminals outwards, shall be provided at both ends of all wiring for easy identification. These shall be interlocking type plastic ferrules.
- 5.7.4 Control wiring circuits, fed from a supply common to a number of feeders, shall be so protected that failure of a circuit in one feeder does not affect the operation of the other feeders.
- 5.7.5 The wiring to the equipment mounted on the doors shall be carried out with flexible multi strand copper conductor cable and supported so that opening of the door, there is no undue strain on wire leads.
- 5.7.6 The control cables shall be neatly arranged and properly supported.
- 5.8 External Cable Termination**
- 5.8.1 All power and control cables shall enter the distribution board from the bottom. Sufficient space shall be provided for ease of connection and termination of cables.
- 5.8.2 All cables shall be of 1.1 KV grade PVC insulated armoured and PVC sheathed except for single core cable which shall be unarmoured. The number and sizes of cable shall be as indicated in Feeder details.
- 5.8.3 Compression type cable glands along with the cable lugs as required shall be provided for termination of cables.
- 5.8.4 The cable glands shall be of rolled Aluminium heavy duty double compression type and shall be mounted on a removable gland plate, provided at a minimum height of 75 mm from the bottom of the distribution board. Two numbers spare knockouts of size 20 mm shall also be provided on the gland plates for future use.
- 5.8.5 For all power cables crimped type aluminium lugs for aluminium cables and tinned copper lugs for copper cables shall be provided.
- 5.8.6 The terminal blocks shall be pressure clamp type up to 35 sq. mm cable and bolted lug type for higher sizes of cables. These shall be protected type and rated for 1100 Volts service. The minimum current rating of terminal block shall be 16 Amp. The construction shall be such that after the connection of cables by means of lugs, necessary clearance and creepage distance are available.
- 5.8.7 Where more than two cables in parallel are required to be terminated, a system of bus links shall be provided with adequate clearance and spacing.
- 5.8.8 Suitable clamps to support the vertical run of cables shall be provided.
- 5.8.9 The terminal block shall be grouped according to circuit functions and suitably numbered. 20% extra terminals shall be provided in the terminal block.

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5.8.10 For power connections, suitable marking on the terminals shall be provided to identify the phases.

5.9 Feeder Details

5.9.1 The requirements of incomer, bus coupler and outgoing feeders shall be as indicated in the single line diagram, feeder details and corresponding schematic diagram.

5.9.2 The bus coupler shall be so located that it is possible to maintain half of the bus-bars while the other half is still alive. Complete segregation of bus-bar connections to bus coupler shall be provided.

5.9.3 Castle key type mechanical interlocks shall be provided between incomers and bus section modules to avoid paralleling of incomers. In addition padlocking facilities shall be provided in OFF position.

5.9.4 Single phase loads shall be distributed as far as possible on all the three phases.

6.0 COMPONENT DETAILS

The components shall conform to type of co-ordination C as per IS/IEC:60947. Makes of all components shall be subject to owner's / consultant's approval

6.1 Moulded Case Circuit Breakers

6.1.1 The circuit breaker shall conform to IS/IEC:60947 and shall be of P2 category having rupturing capacity as per system requirement.

6.1.2 The circuit breaker shall be provided with spring assisted quick make quick break type manually operated trip free mechanism, mechanical ON/OFF position indicators, thermal tripping devices of inverse characteristics, instantaneous short circuit tripping devices and necessary auxiliary and alarm switches. The MCCB cubicle shall be provided with service, test and isolated position and automatic safety shutter.

6.1.3 The thermal and short circuit tripping device shall be adjustable type.

6.1.4 When used for motor circuit shunt trip devices shall be provided and the let through power of controlling MCCB shall be lower than the respective contactor.

6.1.5 In addition, under voltage trip shall be provided, if specified.

6.2 Switches

6.2.1 The switches shall be Motor duty type AC23 category and shall comply with the requirements laid down in IS/IEC:60947. Switches up to 63 Amps shall be rotary type and those of 100 Amp and above shall be link type.

6.2.2 'ON' and 'OFF' positions of the switches shall be indicated on the panel. Provision shall be made to lock the switch in the 'OFF' position.

6.2.3 The fixed contacts shall be shrouded and the contacts shall be silver plated.

6.2.4 Two Pole switches shall also isolate the neutral circuit along with phase circuit. 4 Pole / 2 Pole switches shall be used for 3 Phase/1 Phase circuits respectively.



6.3 Fuses

The fuses shall be of non-deteriorating HRC cartridge link type and conform to IS: 13703. They shall be suitable for the load and the service required in the circuit.

6.4 Air Break Contactors

6.4.1 The Air Break Contactor shall be of AC3 category unless otherwise specified, conforming to IS/IEC:60947 and flapper type. Gravity operated contactors are not acceptable.

6.4.2 The dropout voltage shall not exceed 65% of rated voltage.

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6.4.3 Each contactor shall be provided with auxiliary contacts as required. The rating of the auxiliary contacts shall be 5 Amps. AC or 1 Amp DC at the specified control voltages. The spare auxiliary contacts shall also be wired terminal block.

6.5 **Bimetal Thermal Overload Relays**

6.5.1 The contactor shall be provided with three pole bimetal thermal overload relays unless otherwise specified. The bimetal relays shall be of suitable range, ambient temperature compensated and shall be separate mounting type. They shall be adjustable through graduated scale and shall be provided with changeover contact.

6.5.2 Bimetal relays shall conform to IS: 3231 and shall have built in single phasing preventor.

6.5.3 The bimetal relays shall be provided with a manual reset device resetable after opening the cubicle door. Auto reset thermal relays are not acceptable.

6.6 **Current Transformers**

6.6.1 The current transformers shall conform to IS: 2705.

6.6.2 Current Transformers shall be Class-F insulated and vacuum impregnated. The Current Transformers shall be rigidly mounted and shall be easily accessible for maintenance and testing.

6.6.3 The Current Transformers shall be of 7.5 VA output. The output shall be adequate for the instrument and metering duties involved with sufficient margin. The Current Transformers shall have the accuracy Class-1 for the metering duty.

6.6.4 All the Current Transformers shall be provided with terminals and shorting links. One of the terminals of C.T. shall be earthed. The polarity of the C.T. shall be clearly marked.

6.6.5 The C.T.s shall be capable of withstanding momentary open-circuit on the secondary side without injurious effects.

6.7 **Instruments and Meters**

6.7.1 All instruments shall be flush mounting type with square face and shall be tropicalized and dust tight.

6.7.2 The size of the instruments shall be 96 mm x 96 mm for full and half size modules and 72 mm x 72 mm for lower size modules.

6.7.3 Dials shall be parallax free with scale marked in black on white background and shall be suitable for direct reading.

6.7.4 Zero adjusters shall be provided for operation from the front of the cases.

6.7.5 All ammeters and voltmeters shall have 0 - 240° scale moving iron spring controlled type and of Class 1.5 accuracy as per IS: 1248. The scale range of the ammeter and voltmeter shall be as indicated in the feeder details.



6.7.6 In case of motor feeders, the ammeter shall be graduated uniformly upto C.T. primary current and with a compressed end scale upto 6 times the C.T. primary current. Red pointer shall be provided, which can be adjusted at site for indicating full load current.

6.7.7 KWH meter shall be 3 phase 4 wire type. These shall conform to the requirements of relevant IS and shall be C.T. operated. The current coil shall be rated for 5 Amp.

6.7.8 All kWh meters shall be provided with test blocks for current and voltage coils for testing them at site without interrupting their recording while in service.

6.8 **Push Button and Control Switches**

6.8.1 The switches and push buttons shall conform to utilization category AC 11/DC 11 as per IS/IEC:60947 . The contact shall be rated to make, break and carry inductive current of 5 Amp. at 415 V AC and 1 Amp at 220 V DC.

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6.8.2 The control switches shall be spring return rotary type unless otherwise specified and provided with pistol grip type handle. The control switches for circuit breakers shall be additionally fitted with lost motion devices and sequencing devices.

6.8.3 The selector switches shall be stay-put rotary type and provided with oval shape handles.

6.8.4 The push buttons shall be of momentary contact spring loaded type with a set of normally close and open contacts. The push button for 'Start' shall be shrouded type and coloured green, stop push button shall be un-shrouded type and coloured red and other push buttons shall be un-shrouded type coloured black. The fixing ring shall be metallic white.

6.8.5 Emergency stop push buttons, if specified, shall be lockable in pushed position.

6.9 **Miniature Circuit Breakers**

6.9.1 The miniature circuit breakers shall conform to IS: 13032 and shall be of duty category M-9.

6.9.2 It shall be provided with overload and short circuit protective devices in a heat resistant housing.

6.9.3 A certificate of short circuit rating and current time tripping curve shall be furnished alongwith the offer.

6.10 **Signal Lamps**

6.10.1 Signal lamps shall be provided to indicate the various circuit conditions as shown in scheme drawings. The colour of the lamps for various functions shall be as follows:

Red -- Switch/Contactor closed.
Green -- Switch/Contactor open.

6.10.2 The lamps shall be LED type having lumen output 200 milli candela in axial direction.

6.10.3 It shall be possible to remove the globe from outside for replacement of lamps.

7.0 **ACCESSORIES**

7.1 The supplier shall include the following accessories.

- Fuse Puller.
- Test plug for kWh meters.

7.2 **Space Heater**

Each vertical section shall be provided with a thermostatically controlled space heater, rated for 240 V, 50 Hz and controlled through double pole miniature circuit breaker.

7.3 **Name Plates**

7.3.1 The distribution board shall have large name plate on the top to indicate its name and designation.

7.3.2 Each feeder shall be provided with name plate. Each single front panel shall have name plate both in front and back.



7.3.3 All control switches, push buttons, lamps etc. shall have functional identification labels.

7.3.4 Name plate shall be of black perspex with white engraving and of minimum 3 mm thick.

7.3.5 Any other accessories required, but not specified shall also be supplied to make the distribution board complete in all respects to ensure safe and proper operation.

8.0 **PAINTING**

8.1 The enclosure after degreasing, pickling in acid, cold rinsing phosphatising, passivating etc. shall be painted with two coats of anti-rust paint followed by two coats of anticorrosive paint.

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- 8.2 Epoxy based paint shall be used.
- 8.3 All paints shall be carefully selected to withstand tropical heat and extremes of weather. The paint shall not scale off, crinkle or be removed by abrasion due to normal handling.
- 8.4 Unless otherwise specified, the finishing shade shall be light grey Shade No.631 as per IS: 5.
- 8.5 One litre of paint shall be supplied along with each board for touch up at site.

9.0 TESTS AND INSPECTION

- 9.1 The distribution boards shall be subjected to routine test as per IS: 8623.
- 9.2 Additional tests, wherever specified, shall be carried out.
- 9.3 All the above tests shall be carried out in presence of purchaser's representative. In addition, the equipment shall be subjected to stage inspection during process of manufacture at works and site inspection.
- 9.4 These inspections shall however, not absolve the vendor from his responsibility for making good any defect which shall be noticed subsequently.

10.0 DRAWINGS AND DOCUMENTS

- 10.1 Drawings and documents as per Annexure-I shall be supplied unless otherwise specified.
- 10.2 All drawings and documents shall have the following description written boldly:
- Name of client
 - Name of consultant
 - Enquiry / Order Number with plant / project name
 - Code No. and Description

11.0 SPARES

- 11.1 Commissioning Spares: Commissioning spares, as required, shall be supplied with the main equipment. Item-wise list of recommended commissioning spares shall be furnished for information.
- 11.2 Spare for 2 Years Operation (Mandatory), as specified shall be supplied.
- 11.3 List of Recommend Spares (other than Mandatory Spares) alongwith recommended quantity and item-wise price shall be furnished.
- 11.4 All spare parts shall be identical to the parts used in the equipment.

12.0 PACKING

- 12.1 The distribution board shall be properly packed before despatch to avoid damage during transport, storage and handling.
- 12.2 The packing box shall contain a copy of the installation, operation and maintenance manual.
- 12.3 A sign to indicate the upright position of the panels to be placed during transport and storage shall be clearly marked. Also proper arrangement shall be provided to handle the equipment.

ANNEXURE - I



DOCUMENTATION FOR SHEET STEEL DISTRIBUTION BOARDS

Sl.No.	Documents	Documents Required (Y / N)		
		With Bid	For Approval	Final
1.	Specification Sheet	N	Y	Y
2.	Technical Particulars	N	Y	Y
3.	Feeder Details	N	Y	Y
4.	General Arrangement and Foundation Drawings	N	Y	Y
5.	Schematic Diagrams with Terminal arrangement drawings	N	Y	Y
6.	Calculation for Bus-bar sizing	N	Y	N
7.	Illustrative and Descriptive literature	N	N	Y
8.	Catalogues for bought out accessories	N	N	Y
9.	Installation, Operation and Maintenance Manual	N	N	Y
10.	Test Certificates			
	-- Type (for MCCB & MCB)	N	N	N
	-- Routine	N	N	Y
11.	Guarantee Certificates	N	N	Y
12.	Spare Parts List	N	N	Y

Note:

1. 4 hard copies & 1 soft copy shall be supplied for approval after order within 4 weeks from the date of LOI.
2. 8 hard copies & 2 soft copies in CD shall be submitted as final documents prior to despatch of the equipment. These shall be made in sets and supplied in fine plastic coated folder.

Y - Yes, N - No



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LIGHTING SUB DISTRIBUTION BOARDS

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1.0 SCOPE

- 1.1 This standard covers the technical requirements of design, manufacture, testing at works and delivery in well packed condition of lighting sub distribution boards.
- 1.2 This standard shall be read in conjunction with relevant part of Design Philosophy - Electrical.

2.0 STANDARDS TO BE FOLLOWED

- 2.1 The design, manufacture and testing of the equipment covered by this standard shall comply with the latest issue of the following Indian Standards. Equipment complying with equivalent IEC standards shall also be acceptable

- IS/IEC:60947 - Low voltage switchgear and control gear
- IS: 8623 - Specification for low voltage switchgear and control gear assemblies

- 2.2 The design and operational features of the equipment offered shall also comply with the provisions of latest issue of the Indian Electricity Rules and other relevant statutory acts and regulations. The supplier shall, wherever necessary, make suitable modification in the equipment to comply with the above.
- 2.3 Wherever any requirement, laid down in this standard, differs from that in Indian Standard Specifications, the requirement specified herein shall prevail.

3.0 SERVICE CONDITIONS

3.1 Ambient Conditions

These shall be as indicated in Design Philosophy - Electrical.

3.2 System Details



These shall be as indicated in Design Philosophy - Electrical.

4.0 OPERATING REQUIREMENTS



The lighting sub-distribution boards shall be suitable for operating continuously under the ambient conditions and with the voltage and frequency variations, without exceeding the specified temperature rise and without any detrimental effect on any part.

5.0 GENERAL DESIGN AND CONSTRUCTIONAL FEATURES

- 5.1 The lighting sub distribution boards shall be fabricated out of 2.5 mm thick cold rolled sheet steel and shall be suitable for mounting on wall/structure. These shall have dust and vermin proof construction conforming to IP-65 as per IS/IEC:60947. For outdoor installation, the enclosure shall conform to IPW-55. Suitable canopy made out of 2 mm thick Aluminium sheet shall be supplied along with the board.
- 5.2 The miniature circuit breakers shall be so mounted inside the enclosure that their operating knobs project outside for easy operation. The cut-out for the knobs on the enclosure shall be lined with gasket for dust proofness. For further protection against ingress of dust, the portion where the knobs have protruded out, shall be provided with another external front cover, internally hinged at the top, gravity operated and with a knurled knob at the bottom. The external cover shall be flushed with the main cover. Continuous neoprene gasket shall be provided to make the board completely dust and weather proof.
- 5.3 All external hard ware of diameter less than 8 mm shall be of stainless steel and those of diameter 8 mm and above shall be of mild steel cadmium plated or zinc passivated.

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- 5.4 The sub-distribution boards to be located indoors shall have top entry arrangement for outgoing cables and bottom entry for incoming cable. However for outdoor locations, all cable entries shall be from the bottom only.
- 5.5 Three phase and neutral bus bar system of adequate size shall be provided to which all outgoing and incoming MCB's shall be connected.
- 5.6 The internal wiring shall be carried out by means of single core PVC insulated 2.5 sq. mm stranded copper conductor cables.
- 5.7 Two earthing terminals outside the board shall be provided.
- 5.8 Suitable label inscription consisting of black perspex with engraving for the board and circuit nos. of all outgoing feeders shall be provided. The label inscription of the board shall contain description and code no. The circuit nos. of outgoing feeders shall be serially indicated as 1L, 2L.....17L, 18L.
- 5.9 The board shall be complete with terminal block, cable glands, cable lugs and other accessories as specified.
- 6.0 SPECIAL FEATURES FOR FLAME PROOF LIGHTING SUB DISTRIBUTION BOARDS**
- 6.1 The enclosure shall be in addition of flame proof execution as per IS: 2148.
- 6.2 The enclosure group and temperature class shall be as indicated in Design Philosophy – Electrical.
- 6.3 The enclosure shall be of cast iron/cast Aluminium alloy (4600 as per IS: 617).
- 6.4 Cables shall enter the terminal chamber through flame proof compression type cable glands. From terminal chamber to the main enclosure connection shall be made through bushings. Direct entry of external cables into the main enclosure shall not be accepted.
- 6.5 The sub-distribution board shall be of 6 way type.
- 6.6 Individual earth terminals shall be provided for the earth conductor of the outgoing cables beside the phase and neutral terminals.
- 6.7 The sub-distribution board must be certified by Central Mining Research Institute, Dhanbad or other statutory authority for use in specified hazardous area.
- 7.0 COMPONENT DETAILS**
- 7.1 The lighting sub-distribution board shall be wired and have components as per SD-8083 (copy attached).
- 7.2 **Miniature Circuit Breaker (MCB)**
- The MCB shall be of duty category M-9 and shall conform to IS/IEC:60898-1:2002. It shall be provided with overload and short circuit protective devices. MCB shall be of C Curve Type.
- 7.2.1 The incoming MCB's or switches shall be of triple pole and switched neutral type and outgoing MCB's of single pole and switched neutral type, single phase earth leakage protection in each phase of the incomer shall be provided.
- 7.3 **Terminal Block**
- Pressure clamp type terminal blocks shall be provided both for incoming and outgoing cables. The rating of the terminal block shall be at least 1.5 times the rating of the MCB.
- 7.4 **Cable Glands**
- Heavy duty double compression type Aluminium cable glands suitable for PVC insulated, armoured and PVC sheathed 1.1 KV grade incoming and outgoing cables shall be provided.

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8.0 PAINTING

- 8.1 The enclosure after suitable pre-treatment shall be painted with two coats of anti rust paint followed by two coats or anticorrosive paint.
- 8.2 Epoxy based paint shall be used.
- 8.3 All paints shall be carefully selected to withstand tropical heat and extremes of weather. The paint shall not scale off, crinkle or be removed by abrasion due to normal handling.
- 8.4 The finishing shade shall be light grey shade no.631 as per IS: 5.

9.0 TESTS AND INSPECTION

- 9.1 All the lighting sub-distribution boards shall be subjected to routine tests as per IS: 8623.
- 9.2 Additional tests, wherever specified, shall be carried out on one lighting sub-distribution board of each type.
- 9.3 The above mentioned tests shall be carried out in the manufacturer's works in the presence of purchaser's representative. In addition, the equipment shall be subjected to stage inspection at works and inspection at site for final acceptance.
- 9.4 The purchaser's inspection shall, however, not absolve the vendor from his responsibility for making good any defects which may be noticed subsequently.

10.0 DRAWINGS AND DOCUMENTS

- 10.1 Drawings and documents as per Annexure-I shall be supplied, unless otherwise specified.
- 10.2 All drawings and documents shall have the following description written boldly.
- Name of client
 - Name of consultant
 - Enquiry / Order Number with plant / project name
 - Code No. and Description

11.0 SPARES

- 11.1 Commissioning Spares: Commissioning spares, as required, shall be supplied with the main equipment. Item-wise list of recommended commissioning spares shall be furnished for information.
- 11.2 Spare for 2 Years Operation (Mandatory), as specified shall be supplied.
- 11.3 List of Recommend Spares (other than Mandatory Spares) alongwith recommended quantity and item-wise price shall be furnished.
- 11.4 All spare parts shall be identical to the parts used in the equipment.

12.0 PACKING

- 12.1 The equipment shall be properly packed to safeguard against weather conditions and handling during transit. It shall be wrapped in polythene bags and an additional wrapping of bitumen paper shall also be provided to make it completely water proof before the equipment is packed in wooden crates.
- 12.2 The packing box shall contain a copy of the installation, operation and maintenance manual.

ANNEXURE - I

DOCUMENTATION FOR LIGHTING SUB DISTRIBUTION BOARDS

SL.NO.	Description	Documents Required (Y / N)		
		With Bid	For Approval	Final
1.	Specification Sheet	N	Y	Y
2.	Technical particulars	N	Y	Y
3.	General arrangement Drgs.	N	Y	Y
4.	Certificate for flameproofness from statutory testing authority wherever applicable	N	N	Y
5.	Schematic diagram	N	Y	Y
6.	Descriptive literature of Various equipment	N	N	Y
7.	Guarantee certificate	N	N	Y
8.	Test certificate	N	N	Y

Note:

1. 4 hard copies & 1 soft copy shall be supplied for approval after order within 4 weeks from the date of LOI.
2. 8 hard copies & 2 soft copies in CD shall be submitted as final documents prior to despatch of the equipment. These shall be made in sets and supplied in fine plastic coated folder.

Y - Yes, N - No



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TECHNICAL SPECIFICATION INDUCTION MOTOR

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ANNEXURE - I	DOCUMENTATION FOR INDUCTION MOTORS

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1.0 SCOPE

- 1.1 This standard covers the technical requirements of design, manufacture, testing at works and delivery in well-packed condition of medium voltage and high voltage induction motors.
- 1.2 This standard shall be read in conjunction with relevant part of Design Philosophy - Electrical.

2.0 STANDARDS TO BE FOLLOWED

- 2.1 The design, manufacture and testing of the equipment covered by this standard shall comply with the latest issue of IS-325 and other relevant Indian Standards, unless otherwise specified. Equipment complying with equivalent IEC standards shall also be acceptable.
- 2.2 The design and operational features of the equipment offered shall also comply with the provisions of latest issue of the Indian Electricity Rules and other relevant Statutory Rules & Regulations. The supplier shall, whenever necessary, make suitable modification in the equipment to comply with the above mentioned rules.
- 2.3 Flame proof motors shall, in addition, comply with the requirements laid down in IS: 2148.
- 2.4 Increased safety motors shall, in addition, comply with the requirements laid down in IS: 6381.
- 2.5 Motors with type of protection “n” shall, in addition, comply with the requirements laid down in IS: 9628.
- 2.6 Wherever any requirement laid down in this standard differs from that in Indian Standard Specifications, the requirement specified herein shall prevail.

3.0 SERVICE CONDITIONS

3.1 Ambient Conditions

The ambient conditions shall be as indicated in the Design Philosophy - Electrical.



3.2 System Details

- 3.2.1 The details of power system to which the motors will be connected shall be as indicated in the Design Philosophy - Electrical.
- 3.2.2 The motors shall be suitable for connection to a power system where transient disturbances are very likely to occur. During the transient disturbances, voltage of the system may completely disappear and return in a short time with the motors still running and connected. Under this condition, the return of voltage may occur at such an instant that the induced e.m.f. in the motor is in phase with the applied voltage giving rise to current surges which may reach a value equal to 1.6 times the starting current and also cause transient torques of large magnitudes.

4.0 GENERAL DESIGN FEATURES

4.1 Enclosure

- 4.1.1 The enclosure of motors for indoor and outdoor services shall be IP-54 and IPW-55 respectively as per IS/IEC:60529, unless otherwise specified.
- 4.1.2 Motors for outdoor service shall be provided with special seals for the enclosure, joints, bearing housing, terminal boxes etc. so that no extra protective covering for ingress of water shall be required.

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- 4.1.3 Vertical motors for outdoor installation shall be provided with a rain protective hood.
- 4.1.4 All external hardware shall be zinc passivated or cadmium plated.
- 4.1.5 The enclosure shall be provided with threaded metallic plug to permit drainage of condensed water from the inside.

4.2 **Cooling**

- 4.2.1 All motors shall be totally enclosed fan cooled conforming to IC-0141 as per IS: 6362 unless otherwise specified.
- 4.2.2 In case of CACA construction, the same shall conform to IC-0161 as per IS: 6362.
- 4.2.3 In case of CACW construction, the same shall conform to ICW 37A 91 as per IS: 6362.
- 4.2.4 Wherever service conditions are such that corrosive agents are present in the surroundings, the following materials of construction for cooling tubes shall be adopted, unless otherwise specified.

For CACA motor - Aluminium tubes having minimum thickness of 1.6 mm

For CACW motor - Low carbon alloy steel

- 4.2.5 In case of CACW motors, the cooling tubes and flanges shall also be suitable for the cooling water analysis. Trays shall be provided for collection of leaking water with arrangement for its drainage.
- 4.2.6 The cooling fans shall be suitable for bidirectional rotation of motors. These shall be fastened to the motor shaft by means of compensating rings or will be balanced independent of the motor. Guide key or reference points shall be supplied to prevent wrong assembly. The cooling air shall be sucked from the non-driving end.
- 4.2.7 The cooling fans shall be made of non-sparking materials such as cast Aluminium (LM-6 alloy) / cast iron.

4.3 **Direction of Rotation**

- 4.3.1 Motors shall be suitable for both directions of rotation. In case of any design limitation, the same shall be indicated in the offer.
- 4.3.2 In either case, a plate showing the direction of rotation corresponding to the phase terminal markings shall be fitted at the driving end shield of the motors.

4.4 **Stator**



- 4.4.1 The stator laminations shall be made from suitable magnetic sheet iron varnished on both sides. Where ventilation is required, these shall be arranged in suitable packs, each pack being separated by spacers to form ventilating ducts for circulation of air.
- 4.4.2 The slot shall be open type with coils so arranged that the coils can be easily removed for inspection and repair.

4.5 **Rotor**

- 4.5.1 The rotor shall be of squirrel cage construction, unless otherwise specified.
- 4.5.2 For small motors, the squirrel cage shall preferably be of pressure die-cast construction. For large motors, the rotor bars and the end rings shall be of copper or copper alloy. The bars shall be firmly placed in slots to prevent vibration during start up / locked rotor condition. Conductor ends shall be securely fixed to the end rings using the latest brazing techniques. Retaining rings shall be provided for high speed machines for the end rings. The rotor cage shall be designed for the required starting and duty cycles.

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- 4.5.3 Wherever wound rotor is specified, the windings shall have the same features as detailed for the stator windings. The rotor voltage shall not exceed the stator voltage.
- 4.5.4 The rotor shall be dynamically balanced and shall rotate perfectly with no preferential stop points. The rotor shall be constructed such as to allow the removal or addition of material for balancing.
- 4.5.5 The rotor shaft shall be electrically and magnetically so balanced that the induced shaft voltage does not exceed 200 millivolt. Otherwise the bearing housing at non-driving end shall be insulated for 2 KV.
- 4.6 **Windings and Insulation**
- 4.6.1 The motor coils shall be made out of insulated electrolytic grade copper conductor. Successive coils shall be connected by accessible joints, well brazed and finished smooth to prevent damage to insulation.
- 4.6.2 The motors shall be insulated assuming the power system neutral as isolated.
- 4.6.3 All motors shall be insulated with F insulation with tropical and fungicidal treatments.
- 4.6.4 Wherever class F insulation is specified, the windings shall be easily replaceable type and the temperature rise shall not exceed that of class B insulation.
- 4.6.5 The winding coils shall be dried, properly impregnated with suitable varnishes to withstand the site conditions and properly baked. At least two additional impregnations and baking shall be applied to the assembled stator coil, making a total of three impregnations and baking. Finally the windings shall be painted with special anti-acid and anti-alkali paints to withstand the site conditions.
- 4.6.6 The windings shall be well brazed and capable of withstanding thermally and mechanically the transient disturbances specified under clause 3.2.2.
- 4.6.7 Lead-in wire between the windings and the outside terminals shall be made through bushings in H.V. motors. For M.V. motors, heat resistant insulated conductors shall be used as lead-in wire.
- 4.6.8 The windings shall be star connected for high voltage motors and delta connected for medium voltage motors.
- 4.7 **Slip Rings and Brushes**
- 4.7.1 Slip rings shall be located in the non-driving side. The material of construction shall be copper alloy. The slip rings and the brush gear shall be cooled by the motor cooling fan.
- 4.7.2 For explosion proof motors, the slip rings and brush gear shall be housed in a flameproof housing. In case this is not possible, the housing shall be pressurised type with flameproof pressure switch for interlocking with the motor. In either case, glass covers shall be provided for inspection.
- 4.7.3 The starting rheostats shall be designed for intermittent duty and rated for 10 minutes. Where speed regulation is required, the rheostats and the controllers shall be suitable for such duty and be continuously rated. Auxiliary contacts shall be provided on the controllers for connections to the motor supply controls to prevent wrong operations during starting.
- 4.8 **Bearings**
- 4.8.1 All motors shall be provided with bearings suitable for the application. The bearings shall have a smooth operation and a life not shorter than 30,000 hrs.

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- 4.8.2 Where external thrusts are specified, the motors shall be fitted with special roller thrust bearings capable of withstanding the specified thrust. In such cases, the life of the bearings shall not be less than 20,000 hours.
- 4.8.3 The bearing housing shall be effectively sealed against ingress of dust and water and creep age of lubricants along the shaft.
- 4.8.4 The bearing shall be suitable for both directions of rotation of the motor.
- 4.8.5 All motors shall be provided with on-line grease lubrication arrangement for both DE and NDE side bearings except for motors of frame size 112 and less and flange mounted M.V. motors. The arrangement shall be complete with grease nipple and drain plug located at convenient locations.
- 4.8.6 All oil lubricated bearings shall be fitted with oil level indicator and resistance temperature detector/dial type thermometer with alarm and trip contacts.
- 4.8.7 Self cooled bearing system shall be preferred.
- 4.8.8 The manufacturer shall specify the type of lubricant and the time interval of lubrication for the bearings of each motor.
- 4.8.9 The bearing temperature shall not exceed 90°C for grease lubricated bearings and 70°C for oil lubricated bearings.
- 4.8.10 Wherever shaft end-play has been specified, the bearings shall be capable of providing the specified end-play.
- 4.9 **Terminal Box**
- 4.9.1 All the terminal boxes shall have identical degree of protection as that of the motor.
- 4.9.2 The power terminal box shall be mounted on the right hand side of the motor as viewed from the coupling end. For M.V. Motors, design of terminal boxes shall be such that it may be possible to arrange top/bottom/side entry of cables at site.
- 4.9.3 The power terminal boxes shall be as follows:
- a) For H.V. motors - Phase segregated type capable of with standing the system fault level for 0.2 Sec. or more.
 - b) For M.V. motors - Manufacturer's standard box with epoxy or SRBF moulded terminal board.
- 4.9.4 The mounting arrangement of power and neutral side terminal boxes for HV motors shall be identical so that it shall be possible to interchange the boxes at site.
- 4.9.5 In case of H.V. motors, all the six leads of the motors shall be taken out, three on one side and three on the other side to separate terminal boxes. However, neutral shorting link shall be provided on the neutral box for star connection.
- 4.9.6 In case of M.V. motors, all the six leads of the motors shall be taken out to a common terminal box. Shorting links for delta connections shall be provided in the terminal box for motors 112 frame and above.
- 4.9.7 For increased safety motors and for motors with type of protection "n", the terminals shall be provided with positive locking device so that they do not become loose during normal operation.
- 4.9.8 The power terminal boxes shall have adequate clearances in between the terminals and also between the terminals and cable gland for proper termination of cables. Where more than one cable is required to be terminated in parallel, the spacing in the box shall be adequate for easy termination.

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- 4.9.9 Separate terminal boxes shall be provided for connection of power, control and space heater cables.
- 4.9.10 All terminal boxes shall be complete with heavy duty double compression type cable glands and lugs/connectors to receive the external cables.
- 4.9.11 Where cross linked polyethylene cables are specified, the terminal box shall be suitably designed for proper termination of such cables.
- 4.9.12 The cable lugs shall be of tinned copper and suitable for crimping.

4.10 **Geared Motors**

Where geared motors are specified, the gears shall be oil lubricated, heavy duty as per AGMA class III and capable of transmitting the rated motor power continuously. They shall be capable of withstanding moderate shock loads having a service factor of 2 and the starting duties. They shall be silent and smooth in operation. Inspection glass shall be provided to indicate the oil level in the gear box.

5.0 **PERFORMANCE**

5.1 **Starting**

- 5.1.1 The motors shall be capable of being started direct-on-line, unless otherwise specified.
- 5.1.2 The starting torque of each motor shall be higher than the initial resisting torque of the driven load throughout the starting period even at a feeding voltage of 85% of the rated voltage for normal purpose motor and 80% of the rated voltage for special purpose motor.
- 5.1.3 The starting current of 415 V Motors shall not exceed the values indicated in IS: 12615. Also there shall be no further positive tolerance on the values of starting current.
The starting current of 11 KV & 3.3 KV motors shall not exceed 550% of FLC. No positive tolerance is acceptable over 550% FLC.
- 5.1.4 The motors shall be suitable for the following starting cycle:
- a) With the motor at ambient temperature - 2 successive starts and 3rd start after 5 minutes.
 - b) With the motor at steady state load temperature - 1 immediate start and 2nd start after 5 minutes. This sequence shall be repeated in the next hour.
- 5.1.5 Speed switch shall be provided, wherever required, to fulfil the starting conditions.

5.2 **Locked Rotor Condition**

- 5.2.1 The locked rotor withstand time (t_E), under hot condition at 110% of rated voltage shall be more than the starting time of the motor coupled to the load even at the lowest stipulated starting voltage by 2 secs. for motors, having starting time up to 10 secs. and by 5 secs. for motors, having starting time more than 10 secs.
- 5.2.2 For increased safety motors, t_E under hot condition shall not be less than 10 secs. The value of t_E shall be determined in the presence of purchaser's representative unless test certificate from an independent testing authority is submitted for similar motors. The time t_E and the locked rotor current shall be stamped on the name plate as well as indicated in the test certificates.
- 5.2.3 For deciding the time t_E in all cases, the temperature of the insulated stator and rotor shall not exceed the value stipulated under clause no. 5.4.3.

5.3 **Running**

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- 5.3.1 All motors shall be continuous maximum rated (S1 duty as per IS: 325), unless otherwise specified.
- 5.3.2 The motors shall be capable of delivering the rated output without exceeding the specified temperature rise under the system voltage and frequency variation conditions.
- 5.3.3 The motors shall be suitable for running at the rated load for 5 minutes duration at 80% voltage and for 1 Sec. duration at 70% voltage, without exceeding the specified temperature rise.

5.4 **Temperature Rise**

- 5.4.1 The total temperature of the stator winding under full load running condition shall not exceed the values permissible for the specified insulation class. For increased safety motors, the total temperature shall be 10°C less than for normal motors.
- 5.4.2 For explosion proof motors, the maximum surface temperature shall not exceed the values applicable for temperature class of the hazardous gases / vapours present in the surrounding area. However for type 'n' motors, the maximum allowable temperature shall not exceed 200°C.
- 5.4.3 In case of starting and locked rotor conditions stipulated under clause nos. 5.1.4 and 5.2.1 respectively, the maximum temperature in the rotor shall not exceed the following values:
- | | | |
|---------------------------|---|--|
| For squirrel cage rotor | - | 300°C |
| For wound rotor | - | As applicable to the insulation class |
| For explosion proof motor | - | As per temperature class of the hazardous gases / vapours, without exceeding the above temperature as applicable |

6.0 **COUPLING DETAILS**

- 6.1 Unless otherwise specified, all motors shall be coupled to the driven equipment through flexible coupling.
- 6.2 Normally the coupling half for the motor shaft shall be supplied by the driven equipment supplier. The coupling half shall be keyed on the shaft with a tapered joint or shrunk with a straight joint. For this purpose, the motor manufacturer shall coordinate all details of the coupling system with the driven equipment manufacturer, wherever required.
- 6.3 Where rigid coupling is specified, the motor shaft shall have the desired class of accuracy.
- 6.4 For all vertical flange mounted motors, the limitations on shaft extension, run out, perpendicularity and eccentricity, as required by the driven machine supplier shall be complied with by the motor supplier.
- 6.5
- i) If the motor is to be coupled to a reciprocating pump or compressor requiring fluctuating torque, the motor supplier shall ensure that the inertia of the driving and driven machine assembly shall be such that the variation in the armature current shall not exceed $\pm 66\%$ of the rated current while delivering full load.
 - ii) The measurement of armature current shall be done with the oscillograph.
 - iii) The additional fly wheel, if any, shall be assembled at such a distance from the motor so as to allow easy inspection of the windings.
 - iv) All necessary coordination with driven equipment manufacturer shall be carried out by the motor manufacturer.

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- 6.6
- i) Wherever belt drive is specified, the motor supplier shall ensure that the shaft extension and the bearings are suitable for the duty specified.
 - ii) Unless otherwise specified, the slide rails for all belt driven motors shall be supplied by the motor manufacturer.

7.0 ACCESSORIES

The motors shall be complete with all the accessories.

7.1 Space Heaters

7.1.1 Space heaters rated for 240 V A.C. shall be provided to keep the winding dry for all high and medium voltage motors, except for motors rated below 30 KW which shall be suitable for space heating by connecting 24 V A.C to any of the two motor winding terminals.

7.1.2 The location of the space heaters shall be such as to allow easy access for inspection, maintenance and replacement.

7.2 Name Plates

7.2.1 The name plates shall be of stainless steel with letters embossed on them.

7.2.2 The name plate shall contain all the relevant details as per IS: 325 and in addition shall indicate the following:

- i) The description and code no. of motor
- ii) Degree of protection of enclosure
- iii) Temperature rise of windings under running condition
- iv) Designation of bearings
- v) Recommended type of lubricant and interval of lubrication
- vi) Direction of rotation
- vii) Mounting Arrangement

7.2.3 Flameproof motors shall have additional name plate containing relevant particulars as per IS: 2148.

7.2.4 Increased safety motors shall have additional name plate containing relevant particulars as per IS: 6381.



7.2.5 Motors with type of protection “n” shall have additional name plate containing relevant particulars as per IS: 9628.

7.3 Embedded Temperature Detectors

7.3.1 All high voltage motors shall be provided with 6 nos. of evenly distributed embedded resistance temperature detectors for measurement of winding temperature. These shall be located in positions at which the highest temperatures are likely to occur.

7.3.2 In addition, the high voltage motors shall be provided with

- i) 1 no. RTD for hot air temperature measurement
- ii) 2 nos. RTDs (1 on each side) for bearing temperature measurement of oil lubricated bearings. For grease lubricated bearings, RTD shall be provided only where specified

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7.3.3 These RTDs shall be of platinum having 100 ohm resistance at 0°C and temperature coefficient as 3.850×10^{-3} .

7.3.4 The RTDs shall be 3 lead type having power frequency insulation level of 2KV.

7.3.5 The RTDs shall comply with the requirements laid down in IS: 2848.

7.4 **Dial Type Thermometers**

7.4.1 In high voltage motors, the measurement of hot air and bearing temperature (of oil lubricated bearings) by dial type thermometers shall be provided wherever specified.

7.4.2 The arrangement shall consist of a dial type of mercury-in-steel thermometer so mounted that its stem shall be located in the maximum temperature region.

7.4.3 The thermometer shall have two potential free contacts for alarm and trip.

7.4.4 All contacts shall be rated for 2 Amps. at 110 V D.C.

7.4.5 For bearing temperature measurement, separate thermometers shall be provided for each bearing.

7.4.6 For grease lubricated bearings, temperature measurement arrangement shall be provided only where specified.

7.5 **Oil Supply System**

7.5.1 For large sized motors, where forced oil lubrication system is considered, a common oil supply system for the motor and the driven equipment shall be provided by the driven equipment manufacturer.

7.5.2 However, the motor supplier shall quote separate price for the complete oil system of the motor.

7.5.3 The system shall be suitable for location near the motor.

7.5.4 The oil supply system for each motor shall include:

- i) 2 Nos. 100% rated motor driven pumps with motors
- ii) 1 No. oil tank complete with oil level gauge and thermometer
- iii) 1 No. oil cooler
- iv) 1 No. oil filter
- v) 1 No. differential pressure switch for filter
- vi) 2 Nos. pressure switches
- vii) Necessary piping
- viii) Necessary control and interlocks

8.0 **VIBRATIONS**



The motor vibrations measured at the bearings must not exceed the limits specified in IS: 12075.

9.0 **NOISE LEVEL**

The motor noise level shall not exceed 85 dB measured at a distance of 1 metre from the motor.

10.0 **PAINTING**

10.1 Enclosures of the motor and its accessories shall be painted with two coats of anti-rust paint and two coats of anti-corrosive paint after suitable pre-treatment.

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- 10.2 Epoxy paint shall be used.
- 10.3 Unless otherwise specified, the finishing shade shall be light grey having shade No. 631 as per IS: 5.

11.0 TESTS AND INSPECTION

- 11.1 All motors shall be routine tested as per relevant standards.
- 11.2 Additional tests, wherever specified, shall be carried out on one motor of each rating.
- 11.3 For high voltage motors of each rating, polarization index test shall also be carried out.
- 11.4 All the above mentioned tests shall be carried out in the presence of purchaser's representative. In addition, the motor shall be subject to stage inspection at works and inspection at site for final acceptance.
- 11.5 These inspections shall, however, not absolve the vendor from their responsibility for making good any defects which may be noticed subsequently.

12.0 PACKING

- 12.1 The motors shall be properly packed to safeguard against weather conditions and handling during transit.
- 12.2 The shaft shall be properly clamped / supported.
- 12.3 Rust inhibiting agents shall be applied to fittings and sliding surfaces.
- 12.4 All flanges shall be closed with blanking plates to avoid entry of foreign materials.
- 12.5 The loose pieces of the motor / spare parts / Instruments shall be separately wrapped in moisture resistant paper and marked with identification marks and name plate of the corresponding motors.
- 12.6 The packing box / crate shall include a copy of installation, operation and maintenance manual.

13.0 DRAWINGS AND DOCUMENTS

- 13.1 Drawings and documents as per Annexure-I shall be supplied, unless otherwise specified.
- 13.2 All drawings and documents shall have the following descriptions written boldly:
- Name of client
 - Name of consultant
 - Enquiry / order number with plant / project name
 - Motor Code No. and Description

14.0 SPARES

- 14.1 Commissioning Spares : Commissioning spares, as required, shall be supplied with the main equipment. Item-wise list of recommended commissioning spares shall be furnished for information.
- 14.2 Spares for 2 Years Operation (Mandatory), as specified shall be supplied.
- 14.3 List of Recommend Spares (other than Mandatory Spares) alongwith recommended quantity and item-wise price shall be furnished.
- 14.4 All spare parts shall be identical to the parts used in the equipment.

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ANNEXURE - I
DOCUMENTATION FOR INDUCTION MOTORS

Sl. No.	Document Description	Documents Required (Y / N)		
		With Bid	For Approval	Final
1.	Specification Sheet and Technical Particulars	N	Y	Y
2.	Dimensional Drawings	N	Y	Y
3.	Drawings and data for air / water heat exchangers, if necessary	N	Y	Y
4.	Drawings and data for oil system, if necessary	N	Y	Y
5.	Characteristic curves			
	a) Thermal withstand curve	N	Y	Y
	b) Load Vs FL current	N	Y	Y
	c) Load Vs Efficiency	N	Y	Y
	d) Load Vs Power factor	N	Y	Y
	e) Load Vs Speed	N	Y	Y
	f) Voltage Vs Thermal Withstand time	N	Y	Y
	g) Starting current Vs Time	N	Y	Y
6.	Connection diagram for RTDs, thermometer etc.	N	Y	Y
7.	Terminal Box drawings	N	Y	Y
8.	Illustrative and Descriptive catalogues	N	N	Y
9.	Catalogues of bought out accessories	N	N	Y
10.	Spare parts list	N	N	Y
11.	Installation, Operation and Maintenance manual	N	N	Y
12.	Test certificates			
	a) Routine	N	N	Y
	b) Type	N	N	Y
	c) For enclosure	N	N	Y
13.	Guarantee Certificates	N	N	Y

Note:

1. 4 hard copies & 1 soft copy shall be supplied for approval after order within 4 weeks from the date of LOI.
2. 8 hard copies & 2 soft copies in CD shall be submitted as final documents prior to despatch of the equipment. These shall be made in sets and supplied in fine plastic coated folder.

Y - Yes, N - No



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INTERLOCKING SWITCH SOCKET AND PLUG



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5.0	GENERAL DESIGN AND CONSTRUCTIONAL FEATURES
6.0	SPECIAL FEATURES FOR FLAME PROOF SWITCH SOCKET AND PLUGS
7.0	COMPONENT DETAILS
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ANNEXURE - I	DOCUMENTATION FOR INTERLOCKING SWITCH SOCKET AND PLUG



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1.0 SCOPE

- 1.1 The standard covers the technical requirements of design, manufacture, testing at works and delivery in well packed condition of interlocking switch socket and plug.
- 1.2 The standard shall be read in conjunction with relevant part of Design Philosophy - Electrical.

2.0 STANDARDS TO BE FOLLOWED

- 2.1 The design, manufacture and testing of the equipment covered by this standard shall comply with the latest issue of IS-4160/ IEC-309 and other relevant Indian Standards, unless otherwise specified. Equipment complying with equivalent IEC standards shall also be acceptable.
- 2.2 The design and operational features of the equipment offered shall also comply with the provisions of latest issue of Indian Electricity Rules and other statutory acts and regulations. The supplier shall, wherever necessary, make suitable modifications in the equipment to comply with the above.
- 2.3 Wherever any requirement, laid down in this standard differs from that in Indian Standard Specifications, the requirement specified herein shall prevail.

3.0 SERVICE CONDITIONS

3.1 Ambient conditions

These shall be as indicated in Design Philosophy - Electrical.

3.2 System details

These shall be as indicated in Design Philosophy - Electrical.

4.0 OPERATING REQUIREMENTS

The equipment shall be suitable for operating at the rated capacity continuously without exceeding the specified temperature rise and without any detrimental effect on any part.

5.0 GENERAL DESIGN AND CONSTRUCTIONAL FEATURES

- 5.1 The switch socket shall be heavy duty industrial type. The interlocking arrangement shall be such that it is not possible to insert or withdraw the plug with the switch in 'ON' position.
- 5.2 The switch sockets shall have dust, hose and weather proof construction conforming to IPW55 as per IS/IEC:60947 and shall be suitable for outdoor use without any extra protection. All jointing surfaces shall be smoothly machined and of sufficient width to prevent ingress or dust. Further the covers shall be provided with continuous gaskets made of neoprene to prevent ingress of dust and moisture.
- 5.3 The enclosure of switch sockets and plugs shall be of cast aluminium alloy 4600 and suitable for fixing on wall / structure.
- 5.4 The enclosure shall be largely dimensioned in order to avoid temperature rise inside it which may damage the insulating materials and gaskets employed therein.
- 5.5 The insulating materials used shall be non-hygroscopic, mould proof and treated with suitable varnish to withstand the ambient conditions.
- 5.6 All external hardware of diameter less than 8 mm shall be of stainless steel and those of diameter 8 mm or above shall be of mild steel cadmium plated or zinc passivated.
- 5.7 Suitable arrangement for looping of cables from one switch socket to the other shall be provided. For switch sockets rated above 63A, looping shall be done from busbars and



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for switch sockets rated 63A and below, looping may be done from terminal block. Necessary terminals, cable glands and lugs for looping shall be provided. Also one no. The readed plug for each switch socket shall be supplied loose.

5.8 All the relevant information shall be provided on engraved name plate made of aluminium.

5.9 The enclosure shall be provided with two earthing terminals outside the body.

6.0 SPECIAL FEATURES FOR FLAME PROOF SWITCH SOCKET AND PLUGS

6.1 The enclosure shall be in addition of flame proof execution as per IS: 2148.

6.2 The enclosure group and temperature class shall be as indicated in Design Philosophy - Electrical.

6.3 Cable shall enter the terminal chamber through flame proof compression type cable glands. From the terminal to the main enclosure, the connection shall be made through proper bushings. Direct entry of external cables into the main enclosure shall not be accepted.

6.4 An additional earthing terminal inside the terminal chamber shall be provided.

6.5 Switch socket, plug and cable glands must be certified by the Central Mining Research Institute, Dhanbad or any other statutory authority for use in the specified hazardous area.

6.6 Further interlocking shall be provided so that the contacts cannot be energised when the plug and socket are separated.

7.0 COMPONENT DETAILS

Makes of all components shall be subject to owner's / consultant's approval

7.1 Air Break Switches

7.1.1 The switches shall be quick make, quick break rotary type and of utilisation category AC-23 as per IS/IEC:60947.

7.1.2 Switches shall be hand operated from outside the cover. The switch handle shall remain fixed to the front cover while removing the front cover.

7.2 H.R.C. Fuses

7.2.1 The sockets shall be provided with link type HRC fuses.

7.2.2 The fuses shall be capable of withstanding a short circuit current of 50 KA and shall be delayed action type conforming to IS: 13703. These shall be mounted on a shrouded base.

7.3 Socket Outlets

7.3.1 The socket outlet shall be located in the lower part of the enclosure and shall be provided with a threaded aluminium cover attached to the body with G.I. chain, to protect the socket after extraction of the plug. Spring loaded automatic shutter shall not be acceptable.

7.3.2 The socket contacts shall maintain satisfactory spring pressure and contact with the corresponding plug under normal service conditions.

7.3.3 The socket contacts shall be sunk well below the surface of the socket- outlets so as to make it impossible to be touched unintentionally.

7.3.4 An earthing contact shall be provided in the socket outlet which shall ensure making and breaking respectively of its contact with the earthing pin of the plug before and after making and breaking of the corresponding current carrying contacts.



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7.4 **Plugs**

- 7.4.1 The plugs shall be so constructed so that these can be easily fitted in to the socket outlets.
- 7.4.2 These shall be provided with knurled knob arrangement for screwing on the body of the socket so that it can be securely fixed on the top.
- 7.4.3 The plug base and cover shall be firmly secured to each other and shall be sufficiently robust in construction to withstand normal usage.
- 7.4.4 The plug pins shall preferably be of single part. The earthing pin shall be slotted with a single slot and shall be larger in dimension than other pins.
- 7.4.5 The plug and socket contacts shall be self aligning type with best electrical continuity.
- 7.4.6 The plug shall be provided with dust proof cable entry suitable for receiving TRS flexible heavy duty copper conductor cable of specified size. The arrangement shall be such that the conductors are relieved from strain including twisting where they are connected to the terminals and that the outer surface of the cable at the place of entry is not damaged.
- 7.4.7 Insulating barriers forming an integral part of the plug shall ensure separation of metals and bare flexible conductors at different potentials.

7.5 **Cable Termination**

- 7.5.1 Switch socket shall have cable termination arrangement on the upper part of the housing and shall be provided with side entries, one on either side, through heavy duty double compression type rolled aluminium cable glands suitable for 1.1 KV grade PVC insulated armoured and PVC sheathed cables of size.
- 7.5.2 The terminal blocks shall be pressure clamp type for switch socket rated up to 63A and bolted lug type for higher ratings. The terminals shall be rated for at least 1.5 times the switch rating.

8.0 **PAINTING**

- 8.1 The enclosure after suitable pre-treatment shall be painted with two coats of anti-rust paint followed by two coats of anti-corrosive paint.
- 8.2 Epoxy based paint shall be used.
- 8.3 All paints shall be carefully selected to withstand tropical heat and extremes of weather. The paint shall not scale off, crinkle or be removed by abrasion due to normal handling.
- 8.4 The finishing shade shall be light grey shade no.631 as per IS: 5, unless specified otherwise.

9.0 **TESTS AND INSPECTION**

- 9.1 The switch sockets and plugs shall be subjected to routine tests as per IS-4160 and other relevant standards.
- 9.2 Wherever specified, additional tests shall be carried out on one switch socket and plug of each rating.
- 9.3 The tests shall be carried out in the manufacturer's works in the presence of purchaser's representative. In addition to the above tests, the equipment shall be subject to stage inspection at works and inspection at site for final acceptance.
- 9.4 These inspections shall, however, not absolve the vendor from their responsibility for making good any defect which may be noticed subsequently.



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10.0 DRAWINGS AND DOCUMENTS

10.1 Drawings and documents as per Annexure-I shall be supplied, unless otherwise specified.

10.2 All drawings and documents shall have the following descriptions written boldly.

- Name of client
- Name of consultant
- Enquiry / Order Number with plant / project name
- Code No. and Description

11.0 PACKING

11.1 The switch socket and plug shall be properly packed to safeguard against weather conditions and handling during transit. It shall be wrapped in polythene bags and an additional wrapping of bitumen paper shall also be provided to make it completely water proof before the equipment is packed in wooden crates.

11.2 The packing box shall contain a copy of the installation, operation and maintenance manual.

12.0 SPARES

12.1 Commissioning Spares: Commissioning spares, as required, shall be supplied with the main equipment. Item-wise list of recommended commissioning spares shall be furnished for information.

12.2 Spare for 2 Years Operation (Mandatory), as specified shall be supplied.

12.3 List of Recommend Spares (other than Mandatory Spares) alongwith recommended quantity and item-wise price shall be furnished.

12.4 All spare parts shall be identical to the parts used in the equipment.

ANNEXURE – I



DOCUMENTATION FOR INTERLOCKING SWITCH SOCKET AND PLUG

Sl.No.	Description	Documents Required (Y / N)		
		With Bid	For Approval	Final
1.	Specification Sheet	N	Y	Y
2.	Technical Particulars	N	Y	Y
3.	General arrangement and foundation drawing	N	Y	Y
4.	Schematic / wiring diagram	N	Y	Y
5.	Illustrative and descriptive literature	N	N	Y
6.	Catalogue for bought out accessories	N	N	Y
7.	Installation operation and maintenance manual	N	N	Y
8.	Test Certificates			
	a) Type	N	N	Y
	b) Routine	N	N	Y
9.	Guarantee Certificate	N	N	Y
10.	Certificate of flameproofness from statutory testing authority wherever applicable.	N	N	Y
11.	Spare parts list with identification marks	N	N	Y

Note:

1. 4 hard copies & 1 soft copy shall be supplied for approval after order within 4 weeks from the date of LOI.
2. 8 hard copies & 2 soft copies in CD shall be submitted as final documents prior to despatch of the equipment. These shall be made in sets and supplied in fine plastic coated folder.

Y - Yes, N - No

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TECHNICAL SPECIFICATION

BATTERY CHARGER



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4.0	DESIGN AND OPERATIONAL REQUIREMENTS
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ANNEXURE - I	REQUIREMENT OF PROTECTIONS, METERING, CONTROL AND INDICATIONS / ANNUNCIATIONS FOR BATTERY CHARGER
ANNEXURE - II	DOCUMENTATION FOR BATTERY CHARGER

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1.0 SCOPE

- 1.1 This standard covers the technical requirements of design, manufacture, testing at works and delivery in well packed condition of Battery Charger Units.
- 1.2 The standard shall be read in conjunction with relevant part of Design Philosophy - Electrical.

2.0 STANDARDS TO BE FOLLOWED

- 2.1 The design, manufacture and testing of the equipment covered by this specification shall comply with the latest issue of IS: 8623 Specification for low voltage switchgear and control gear assemblies and other relevant Indian Standards, unless otherwise specified. Equipment complying with equivalent IEC standards shall also be acceptable.
- 2.2 The design and operational features of the equipment shall also comply with provisions of the latest issue of the Indian electricity Rules and other relevant Statutory Acts and Regulations. The supplier shall, wherever necessary, make suitable modifications to comply with the above.
- 2.3 Wherever any requirement, laid down in this standard, differs from that in Indian Standard Specifications, the requirement specified herein shall prevail.

3.0 SERVICE CONDITIONS

3.1 Ambient Conditions

These shall be as indicated in Design Philosophy - Electrical.

3.2 System Details

These shall be as indicated in Design Philosophy - Electrical.

4.0 DESIGN AND OPERATIONAL REQUIREMENTS

- 4.1 The Battery Charger Unit and its components shall be suitable for operating at the specified rating continuously with the specified voltage and frequency variations under the ambient conditions without exceeding the temperature rise limits specified in relevant standards and without any detrimental effect on any part.
- 4.2 The battery charger board shall consist of two units as follows:
- (a) Float cum load cum Boost Charger -- To supply continuous load and keep the battery in state in float mode. In Boost mode, for Initial charging of Battery and after power restoration subsequent to failure, to recharge the battery while simultaneously supplying load current.
- (b) A stand by unit for (a) above.
- 4.3 The rated voltage of the float charger for lead acid battery shall be 2.2 Volt/ Cell and final charging voltage of the boost charger shall be 2.75 Volt/ Cell. The rated voltage of the float charger for Ni-Cd shall be minimum 1.4 Volt/ Cell and final charging voltage of the boost charger shall be minimum 1.7 Volt/ Cell. The rated output voltage of the charger under 4.2 (a) above shall be adjustable by $\pm 5\%$ of the rated value manually.
- 4.4 Charging unit stated under 4.2 (a) above shall be fully automatic using silicon controlled rectifiers (SCR) common for Float and Boost service. Charger D.C. output voltage shall be maintained within $\pm 2\%$ irrespective of the input supply variations and load variation of 0 to 100% by closed loop voltage feed back control system. The charger shall be provided with current limit feature.



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- 4.5 The output voltage of the float charger shall be monitored and in case voltage falls below 90% of the rated voltage the stand by charger shall be automatically switched 'ON' with audio-visual alarm and annunciation. Time delay features shall be incorporated to avoid spurious changeover.
- 4.6 Boost charging shall be achieved through the same silicon controlled rectifier (SCR) which shall regulate the charger output automatically by current control closed loop system. Provision for manual adjustment of charger output shall also be made. Charger shall maintain its output current constant at starting rate/ finishing rate of battery charging current irrespective of variation in input supply and battery condition.
- 4.7 Transfer from float charging to boost charging and vice versa shall be automatic as per the battery charge condition.
- 4.8 During boost charging operation, arrangement shall be made so that DC power to load is not interrupted even if AC power fails during this operation. During Boost charge period, battery backup to load shall be arranged by a tapping from suitable point of the battery.
- 4.9 Suitable dropper diodes shall be provided to reduce the voltage across the load to 105% of the rated voltage at rated load current. When power supply to the charger fails, the dropper diodes shall be by-passed automatically through contactor so that full battery output voltage is available to the load.
- 4.10 Provision of suitable filters shall be made so that the ripple in output voltage shall not exceed 3% and 10% for float and boost charger respectively.
- 4.11 It shall be ensured that during boost charging, no over/under charging of cells takes place.
- 4.12 All the automatic features specified above shall also have provision of manual arrangement for control of charging rates and transfer from one charger to others.
- 4.13 Charger unit shall be provided with all required indication, metering, protection, control and alarm annunciation devices for safe and reliable operation and shall include at least as indicated in Annexure-I.
- 5.0 CONSTRUCTIONAL FEATURES**
- 5.1 Each of the charger units shall be housed in separate metal clad cubicles of identical size suitable for floor mounting and arranged to form a compact switchboard.
- 5.2 The complete assembly shall be dust, damp and vermin proof type equivalent to IP-43 as per IS/IEC:60947. In case it is necessary to provide openings for ventilation, these shall be closed from inside by fine wire mesh. Forced ventilated panel shall not be acceptable.
- 5.3 The frame work of cubicles shall be of bolted/welded construction, fabricated out of cold rolled sheet steel of not less than 2 mm thickness. The thickness of base channel shall not be less than 3 mm, suitable reinforcement, wherever necessary, shall be provided.
- 5.4 Hinged doors shall be provided on both the front and back side for easy access. The door hinges shall be concealed type.
- 5.5 The doors and the removable covers shall be provided with non-deteriorating neoprene gaskets. Gaskets without any discontinuity shall be preferred. Gaskets shall be held in position in groove in shaped steel work or these shall be 'U' type. Only one joint per gasket shall be permitted. Adhesive cement, if used, shall be of good quality so that the gaskets do not come off during service.
- 5.6 The mounting of the components shall be such that these are accessible for checking and replacement without the necessity of removing the adjacent ones, at the same time ensuring necessary degree of safety.

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- 5.7 It shall be possible to carry out maintenance of one charger when the other is in operation.
- 5.8 The meters, switches and lamps shall be flush mounted type. All components of one unit shall be mounted on the same unit.
- 5.9 All the live parts shall be insulated. Parts which can not be insulated shall be provided with insulating barriers. These barriers shall provide shielding of all live parts to prevent accidental contact when the door is open. However, for the parts requiring handling normally, such as fuses/lamps etc., separate barriers shall be provided. The barriers in all cases shall cover the cable lug portions and shall be firmly secured, stable and durable. It shall, however, be possible to remove such barriers, if required.
- 5.10 At the equipment termination points, insulated phase barriers, PVC bolt caps, PVC hoses or insulating ribs shall be provided.
- 5.11 The outgoing terminal blocks shall be shrouded type or provided with insulating barriers.
- 5.12 Adequate arrangement for earthing shall be provided to safeguard the Operator or other personnel from electric hazards under all conditions of operation.
- 5.13 **Clearances and Creepage**
The clearances and creepage distances shall not be lower than the values specified below:
- | | | |
|------|---|---------|
| i) | Minimum clearance between two live parts | : 20 mm |
| ii) | Minimum clearance between a live part & earth | : 20 mm |
| iii) | Minimum creepage distance | : 28 mm |
- 5.14 **Insulation**
- 5.14.1 The insulation used shall be non-hygroscopic and may be of porcelain, epoxy resin or glass fibre moulded with plastic. It shall be of adequate electrical and mechanical strength to give trouble free service during normal operation and short circuit conditions.
- 5.14.2 The insulation shall be treated suitably to withstand the tropical conditions and atmospheric pollution as specified.
- 5.15 **Wiring**
- 5.15.1 The switch board shall be completely factory wired and ready for external connections.
- 5.15.2 The wiring shall be complete in all respect so as to ensure proper functioning of control, protection, interlocking and measurement.
- 5.15.3 The wiring shall be carried out with flexible stranded PVC insulated copper conductor cables of 1100 V grade of minimum 1.5 Sq.mm size.
- 5.15.4 All wiring shall be marked with dependent both ends marking as per IS: 5578. Numbered ferrules, reading from the terminals outwards, shall be provided at both ends for easy identification. These shall be interlocking type plastic ferrules.
- 5.15.5 The control cables shall be neatly arranged and properly supported on PVC wiring channel.
- 5.16 **Cable Termination**
- 5.16.1 The boards shall be designed for bottom entry of the power and control cables. Sufficient space shall be provided for ease of connection and termination of cable.
- 5.16.2 Provision for receiving one 415 V, 3 phase 4 wire incoming supply lines, one for each charger shall be made. However, DC output for battery and load shall be looped inside the panel and only one outgoing supply each for battery and load shall be provided.

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- 5.16.3 The termination of cables shall be done through cable glands which shall be suitable for the cables.
- 5.16.4 Heavy duty double compression type rolled Aluminium cable glands shall be provided. The cable glands shall be mounted on a removable gland plate, provided at a minimum height of 75 mm from the bottom of the switchboard. Two spare knockouts of size 20 mm shall also be provided on the gland plate for future addition of control cables.
- 5.16.5 For all power cables, crimped type cable lugs of same material as of conductor shall be provided.
- 5.16.6 The internal power wiring shall be terminated in the terminal blocks for connection to the outgoing cables, These terminal blocks shall be pressure clamp type up to 35 Sq.mm, cable and bolted lug type for higher sizes of cables, These shall be protected type and rated for 1100 V service. The minimum current rating of terminal block shall be 16 Amp. The construction shall be such that after the connection of cables by means of lugs, necessary clearances and creepage distances are available.
- 5.16.7 Not more than two wires shall be connected to any terminal. If necessary a number of terminals shall be jumpered together to provide wiring points.
- 5.16.8 Wherever necessary, suitable clamps to support the vertical run of cables shall be provided.
- 5.16.9 The terminal blocks shall be grouped according to circuit functions and suitably numbered. 20% extra terminals shall be provided in the terminal block.
- 5.16.10 For power connection, suitable marking on the terminals shall be provided to identify the phases.

5.17 **Earth Bus**

- 5.17.1 A continuous earth bus of Aluminium of suitable size minimum 32 x 6 mm shall be run all over the length in the lower part of the board with two ends connected to the external earth terminals of the board.

6.0 **COMPONENT DETAILS**

6.1 **Rectifier Transformer**



This shall be double wound, air cooled, 3 phase type. Class 'F' insulating materials shall be used, with temperature rise limited to Class 'B'. The windings shall be vacuum impregnated.

6.2 **Thyristors and Diodes**

The thyristors and diodes shall be properly selected to have adequate safety margin. A factor of safety of minimum 4 shall be taken for voltage surges and 2 for current ratings. The thyristors and diodes shall be mounted on their respective heat sinks which shall preferably be made of extruded Aluminium properly machined and providing intimate contact with the stud for heat dissipation. Each thyristor/ diode shall be protected with properly designed snubber circuit.

6.3 **Air Break Switches**

The switches shall be heavy duty quick make, quick break type conforming to IS/IEC 60947. Switches shall be snap action rotary type. 'ON'-'OFF' position of the switch shall be boldly indicated. The handle of switches shall remain fastened to the door even when the door is opened after turning the switch 'OFF'. The AC input switch shall not be directly mounted on the door.

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6.4 **Fuses**

For protection of thyristors/ diodes, semi-conductor fuses shall be provided. All other fuses shall be HRC cartridge link type. They shall be suitable for the load and service required.

6.5 **Contactors**

The contactor shall be air break type of category AC-3/ DC-1 as per IS/IEC 60947. DC contactor shall be provided with arc chutes and magnetic blow out coil. The contactors shall not drop out even when the coil voltage drops to 65% of rated voltage.

6.6 **Thermal Overload Relays**

Adjustable bimetal thermal overload relays shall be provided. The bimetal relays shall be ambient temperature compensated. The thermal relays shall be provided with a manual resetting device on the door.

6.7 All ammeters and voltmeters shall be class 1.5 as per IS 1248 and shall be flush mounted type of minimum size 96 x 96 mm. Ammeters and Voltmeters for A.C. service shall be of moving iron type and that for D.C. service shall be moving iron or moving coil type. Zero adjuster shall be provided for operation from the front of the cases.

6.8 **Printed Circuit Boards (PCBs)**

The PCBs shall conform to IS 7405. These shall be of fibre or epoxy glass moulded of minimum thickness 1.5 mm and shall have gold plated contacts and silver or nickel plated tracks. All PCBs shall be of plug-in type contained in a dust proof box. PCBs shall be self diagnostic type and shall be provided with status indication. Metering points shall be provided on each PCB and the PCBs shall be clamped in position so that vibration or long usage does not result in loose contacts.

6.9 **Timers**

The timers shall be electronic, pneumatic or synchronous type conforming to IS: 5834 with manual/auto reset features as per the functional requirements. The repeat accuracy shall be within 5%.

6.10 **Control and Selector Switches**

6.10.1 All the control and selector switches shall be of rotary type with thermal utilization category of AC 11 or DC 11 as per IS/IEC:60947.

6.10.2 The control switches shall be spring return type and provided with pistol grip type handles.

6.10.3 The selector switches shall be stay-put type and provided with oval handle.

6.11 **Signal Lamps**

6.11.1 Signal lamps shall be provided to indicate the various circuit conditions and these shall be placed at a suitable height. The colour of the lamps for various functions shall be as follows:

- Red -- Circuit 'ON'
- Green -- Circuit 'OFF'
- Amber -- Alarm and auto trip.

6.11.2 The lamps shall be LED type having lumen output of 200 millicandella in axial direction.

6.12 **Audio Visual Alarm Annunciation**

6.12.1 A solid state audio-visual alarm annunciation system shall be provided for the board. Audible annunciation shall be provided by means of hooter with provision of remote alarm and acknowledgment. Visual annunciation shall be provided by flashing of the



respective facia window. The facia window shall have translucent glass or plastic cover with inscription in black letters. Each facia window shall be provided with two lamps connected in parallel. The cover plate of the facia window shall be flush with the panel and shall be capable of easy removal to facilitate replacement of lamps.

- 6.12.2 The following operating sequence shall be adopted for audio visual alarm and indication:

System Condition	Visual Signal	Audible Signal
Normal	OFF	OFF
Abnormal	Flashing	ON
Acknowledge	Steady ON	OFF
Return to normal	OFF	OFF
Test	Steady ON	ON

7.0 ACCESSORIES

The supply shall include the following accessories:

7.1 Space Heater

Each cubicle of the board shall be provided with a thermostatically controlled space heater, rated for 240 V, 50 Hz and controlled through double pole miniature circuit breaker. The space heater supply shall be tapped from incomer power supply.

7.2 Name Plates

7.2.1 The board shall have a large name plate on the top to indicate its name and designation.

7.2.2 Each cubicle shall be provided with a name plate.

7.2.3 All control switches, push buttons, lamps etc. shall have function identification labels.

7.2.4 Name plate shall be of black perspex with white engraving of minimum 3 mm thickness.

7.3 Fuse Puller

7.4 Any other accessories required but not specified shall also be supplied to make the board complete in all respects and ensure its safe and proper operation.

8.0 PAINTING

8.1 The enclosure after suitable pre-treatment shall be painted with two coats of anti-rust paint followed by two coats of anti-corrosive paint.

8.2 Epoxy based paint shall be used.



8.3 All paints shall be carefully selected to withstand tropical heat and extremes of weather. The paint shall not scale off, crinkle or be removed by abrasion due to normal handling.

8.4 Unless otherwise specified the finishing shade shall be light grey having Shade No. 631 as per IS 5.

9.0 TESTS AND INSPECTION

9.1 The board shall be subjected to routine tests as per IS 8623 and other relevant standards. Heat run test, if required, shall be carried out.

9.2 Additional tests, wherever specified shall be carried out on one board of each rating.

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9.3 All the above tests shall be carried out in presence of purchaser's representative. In addition, the equipment shall be subjected to stage inspection during process of manufacture at works and site inspection.

9.4 These inspections shall however, not absolve the vendor from his responsibility for making good any defects which may be noticed subsequently.

10.0 DRAWINGS AND DOCUMENTS

10.1 Drawings and documents as per Annexure-II shall be supplied unless otherwise specified.

10.2 All drawings and documents shall have the following description written boldly:

- Name of client
- Name of consultant
- Enquiry / Order Number with plant / project name
- Code No. and Description

11.0 SPARES

11.1 Commissioning Spares : Commissioning spares, as required, shall be supplied with the main equipment. Item-wise list of recommended commissioning spares shall be furnished for information.

11.2 Spares for 2 Years Operation (Mandatory), as specified shall be supplied.

11.3 List of Recommend Spares (other than Mandatory Spares) alongwith recommended quantity shall be furnished.

11.4 All spare parts shall be identical to the parts used in the equipment.

12.0 PACKING

12.1 The board shall be properly packed before despatch to avoid damage during transport, storage and handling.

12.2 The packing box shall contain a copy of the installation, operation and maintenance manual along with one set of drawings.

12.3 A sign to indicate the upright position of the panels to be placed during transport and storage shall be clearly marked. Also proper arrangement shall be provided to handle the equipment.



ANNEXURE - I

REQUIREMENT OF PROTECTIONS, METERING, CONTROL AND INDICATIONS /
ANNUNCIATIONS FOR BATTERY CHARGER

Sl. No.	Description	To be mounted on		
		Float cum Load Charger	Standby Float cum Load Charger	Boost Charger
1	2	3	4	5
1.	A.C. Input Side			
	i) ON/OFF Switch	Yes	Yes	Yes
	ii) HRC Fuses	Yes	Yes	Yes
	iii) Contactor	Yes	Yes	Yes
	iv) Thermal O/L Relay	Yes	Yes	Yes
	v) Single phasing and Phase Reversal	Yes	Yes	Yes
	vi) Voltmeter with SS	Yes	Yes	Yes
	vii) Ammeter with SS	Yes	Yes	Yes
	viii) Signal Lamp (ON/OFF)	Yes	Yes	Yes
2.	Rectifiers			
	i) Semiconductor fuses	Yes	Yes	Yes
	ii) Filters with fuses	Yes	Yes	Yes
	iii) Surge Suppressors	Yes	Yes	Yes
3.	DC Output Side			
	i) ON/OFF Switch	Yes	Yes	Yes
	ii) HRC Fuses	Yes	Yes	Yes
	iii) Blocking Diodes	Yes	Yes	Yes
	iv) Voltmeter	Yes	Yes	Yes
	v) Ammeter	Yes	Yes	Yes
	vi) Signal Lamp (ON/OFF)	Yes	Yes	Yes
	viii) Charging Ammeter (on demand type)	Yes	Yes	Yes



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Sl. No.	Description	To be mounted on		
		Float cum Load Charger	Standby Float cum Load Charger	Boost Charger
1	2	3	4	5
4.	Common Items i) Droper Diodes ii) Solid State facia annunciator for : -- Automatic changeover from one charger to another -- Rectifier fuse failure in float/standby float/boost -- Incoming supply failure float/standby float/boost -- DC output under voltage -- Earth fault -- Single phasing and phase reversal -- Filter fuse failure float/standby float/boost iii) Battery isolating switch and HRC fuses iv) Battery under voltage relay v) Battery earth fault relay vi) DC Contactor	Yes Yes	 Yes	 Yes Yes Yes Yes Yes

NOTE: Any other components as required for satisfactory operation of the battery charger shall be provided.



ANNEXURE - II

DOCUMENTATION FOR BATTERY CHARGER

Sl.No.	Description	Documents Required (Y / N)		
		With Bid	For Approval	Final
1.	Specification Sheet	N	Y	Y
2.	Technical Particulars	N	Y	Y
3.	General arrangement drawings showing overall dimensions of the charger board and mounting details of various equipment inside the charger panel	N	Y	Y
4.	Foundation plan indicating certified dimensions, floor openings, weight, clearance etc.	N	Y	Y
5.	Schematic and Wiring Diagrams	N	Y	Y
6.	Descriptive literature of the charger and various components mounted in the panel.	N	N	Y
7.	Characteristics curves for the charger and all other static and control devices, relays etc.	N	N	Y
8.	Installation, Operation and Maintenance manual	N	N	Y
9.	Guarantee Certificates	N	N	Y
10.	Test Certificates	N	N	Y
11.	Spare parts list with identification marks	N	N	Y

Note:

1. 4 hard copies & 1 soft copy shall be supplied for approval after order within 4 weeks from the date of LOI.
2. 8 hard copies & 2 soft copies in CD shall be submitted as final documents prior to despatch of the equipment. These shall be made in sets and supplied in fine plastic coated folder.

Y - Yes, N - No



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TECHNICAL SPECIFICATION

BATTERY



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2.0	STANDARDS TO BE FOLLOWED
3.0	SERVICE CONDITIONS
4.0	OPERATING REQUIREMENTS
5.0	GENERAL DESIGN AND CONSTRUCTIONAL FEATURES
6.0	ACCESSORIES
7.0	TESTS AND INSPECTION
8.0	DRAWINGS AND DOCUMENTS
9.0	SPARES
10.0	PACKING
ANNEXURE - I	DOCUMENTATION FOR BATTERY



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TECHNICAL SPECIFICATION – BATTERY

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1.0 SCOPE

- 1.1 This standard covers the technical requirements of design, manufacture, testing at works and despatch in well packed condition of batteries and accessories.
- 1.2 This standard shall be read in conjunction with the relevant part of Design Philosophy - Electrical.

2.0 STANDARDS TO BE FOLLOWED

- 2.1 The design, manufacture and testing of the battery shall conform to the latest issue of the following standards:

- IS: 1651 -- Stationary cells & batteries, lead-acid type (with tubular positive plate)
- IS: 1652 -- Stationary cells & batteries, lead-acid type with plante positive plates.
- IS: 10918 -- Vented type nickel cadmium batteries

All accessories shall also conform to the relevant Indian Standard. Equipment complying with equivalent IEC standards shall also be acceptable.

- 2.2 The design and operational features of the equipment offered shall comply with the provisions of the latest issue of the Indian Electricity Rules and other Statutory Acts and Regulations. The supplier shall, wherever necessary, make suitable modifications in the equipment to comply with the above.
- 2.3 Wherever any requirement, laid down in this standard, differs from that in Indian Standard specifications, the requirement specified herein shall prevail.

3.0 SERVICE CONDITIONS

3.1 Ambient Conditions

These shall be as indicated in Design Philosophy - Electrical.

3.2 System Details

These shall be as indicated in Design Philosophy - Electrical.

4.0 OPERATING REQUIREMENTS

The battery shall be able to deliver rated ampere hours when discharged at the 10 hours rate of discharge to a final voltage of 1.85 V per cell for Lead Acid and at the 5 hours rate of discharge to a final voltage of 1.1 V per cell for Ni-Cd battery under the ambient conditions indicated in Design Philosophy - Electrical.

5.0 GENERAL DESIGN AND CONSTRUCTIONAL FEATURES

- 5.1 The battery shall be of Ni-Cd type and rated for 110V. Each battery bank shall consist of 90 number of cells.
- 5.2 The battery bank shall be complete with all necessary components such as lids, plugs, separators and buffers, inter-cell connectors, lead coated bolts and nuts, cell insulators etc.
- 5.3 The required quantity of electrolyte plus 10% extra quantity shall be supplied in suitable non-returnable containers along with the battery.

6.0 ACCESSORIES

The following accessories shall be supplied with each battery bank:-

- (a) 1 Set -- Battery Stand constructed out of teak wood without the use of any metal fastenings and coated with 3 coats of anti-acid paint.



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The stand shall be properly designed so that each cell shall be easily accessible for inspection, topping up etc. However, for Ni-Cd battery mild steel stand with alkali resistant paint may also be accepted

- | | | | |
|-----|--------|----|---|
| (b) | 1 Set | -- | Inter-row, inter-tier and inter-stand connectors and takeoffs. These shall be sized suitably to have adequate current carrying capacity and mechanical strength |
| (c) | 1 Set | -- | Cell Insulators |
| (d) | 1 Set | -- | Stand Insulators |
| (e) | 1 No. | -- | Centre zero cell testing voltmeter scaled 3-0-3 volts |
| (f) | 2 Nos. | -- | Syringe type Hydrometers for measuring the specific gravity of the electrolyte |
| (g) | 2 Nos. | -- | Gravity correction thermometers, mercury-in-glass type |
| (h) | 1 Set | -- | Connecting bolt wrenches |
| (i) | 1 No. | -- | Rubber syringe for tapping cells |
| (j) | 1 No. | -- | Wall mounting type teak wood holder for Hydrometer and Thermometer. |
| (k) | 1 No. | -- | Acid/Alkali resisting funnel. |
| (l) | 1 No. | -- | Acid/Alkali resisting jug. |
| (m) | 1 Pair | -- | Rubber gloves. |
| (n) | 1 No. | -- | Rubber Apron. |



All other accessories, not specified above, but required for satisfactory operation and maintenance shall also be supplied.

7.0 TESTS AND INSPECTION

- 7.1 Type tests shall be carried out as per relevant standards on two cells in the presence of Purchaser's representative.
- 7.2 Acceptance tests shall be carried out as per relevant standards on each cell after installation at site.
- 7.3 In addition, the battery shall be subjected to stage inspection at works and inspection at site for final acceptance.
- 7.4 These inspections shall, however, not absolve the vendor from his responsibilities for making good any defect which may be noticed subsequently.

8.0 DRAWINGS AND DOCUMENTS

- 8.1 Drawings and documents as per Annexure-I shall be furnished by the Vendor unless otherwise specified.
- 8.2 All drawings and documents shall have following description written boldly:
- Name of client
 - Name of consultant
 - Enquiry / Order Number with plant / project name
 - Code No. and Description

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9.0

SPARES

- 9.1 Commissioning Spares : Commissioning spares, as required, shall be supplied with the main equipment. Item-wise list of recommended commissioning spares shall be furnished for information.
- 9.2 Spares for 2 Years Operation (Mandatory), as specified shall be supplied.
- 9.3 List of Recommend Spares (other than Mandatory Spares) alongwith recommended quantity shall be furnished.
- 9.4 All spare parts shall be identical to the parts used in the equipment.

10.0

PACKING

The battery cells and accessories shall be properly packed to safeguard against weather conditions and rough handling. It shall be wrapped in polythene bags with an additional wrapping bitumen paper to make it completely water proof before it is packed in crates. The packing box shall contain a copy of the installation operation and maintenance manual.

ANNEXURE – I



DOCUMENTATION FOR BATTERY

Sl. No.	Description	Documents Required (Y / N)		
		With Bid	For Approval	Final
1.	Specification Sheet	N	Y	Y
2.	Technical Particulars	N	Y	Y
3.	Dimensional drawings showing the cell arrangement on stand (Plan, front and side elevation) for each type of battery.	N	Y	Y
4.	Illustrative and descriptive literature giving the complete details of construction of battery	N	N	Y
5.	Operation and maintenance instructions	N	N	Y
6.	Test Certificates			
	-- Type	N	N	N
	-- Acceptance	N	N	Y
7.	Guarantee Certificates	N	N	Y
8.	Spare Parts lists	N	N	Y

Note:

1. 4 hard copies & 1 soft copy shall be supplied for approval after order within 4 weeks from the date of LOI.
2. 8 hard copies & 2 soft copies in CD shall be submitted as final documents prior to despatch of the equipment. These shall be made in sets and supplied in fine plastic coated folder.

Y - Yes, N - No



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TECHNICAL SPECIFICATION

CABLES

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3.0	SERVICE CONDITIONS
4.0	OPERATING REQUIREMENTS
5.0	GENERAL DESIGN AND CONSTRUCTIONAL FEATURES
6.0	SPECIAL PURPOSE CABLES
7.0	CABLE DRUM
8.0	TESTS AND INSPECTION
9.0	DRAWINGS AND DOCUMENTS
ANNEXURE - I	DOCUMENTATION FOR CABLES

	TALCHER FERTILIZERS LIMITED TECHNICAL SPECIFICATION - CABLES	PC183-TS-0815	0	
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1.0 SCOPE

- 1.1 This standard covers the technical requirements of design, manufacture, testing at works and dispatch in well packed condition of power and control cables.
- 1.2 The standard shall be read in conjunction with relevant part of Design Philosophy - Electrical and other relevant references as specified therein.

2.0 STANDARDS TO BE FOLLOWED

- 2.1 The design, manufacture and testing of cables covered by this standard shall comply with the latest issue of following Indian Standards, unless otherwise specified. Equipment complying with equivalent IEC standards shall also be acceptable.

IS: 1554 Part (I) -- PVC insulated (heavy duty) electric cables for working voltages upto and including 1100 volts.

IS: 1554 Part (II) -- PVC insulated (heavy duty) electric cables for working voltages from 3.3 KV upto and including 11 KV.

IS: 7098 Part (I) -- Cross linked polyethylene insulated PVC sheathed cables for working voltages upto and including 1100 volts.

IS: 7098 Part (II) -- Cross linked polyethylene insulated PVC sheathed cables for working voltages from 3.3 KV upto and including 33 KV

IS: 694 -- PVC insulated cables for working voltages upto and including 1100 volts

IS: 5831 -- PVC insulation and sheath of electric cables

- 2.2 The design and operational features of the cables offered shall also comply with the provisions of latest issue of the Indian Electricity Rules and other relevant Statutory Rules & Regulations. The supplier shall, whenever necessary, make suitable modification in the cables to comply with the above mentioned rules.
- 2.3 Wherever any requirement, laid down in this standard, differs from that in Indian Standard Specifications, the requirement specified herein shall prevail.

3.0 SERVICE CONDITIONS

3.1 Ambient Conditions

These shall be as indicated elsewhere in Design Philosophy - Electrical.

3.2 System Details



These shall be as indicated elsewhere in Design Philosophy - Electrical.

4.0 OPERATING REQUIREMENTS

The cables shall be suitable for operating continuously at the rated capacity as specified in relevant I.S. under the ambient conditions without exceeding the permissible temperature rise and without any detrimental effect on any part.

5.0 GENERAL DESIGN AND CONSTRUCTIONAL FEATURES

- 5.1 The design, manufacture and workmanship of cables shall be in accordance with the latest practice.
- 5.2 All materials to be used shall be new, unused and of the best quality.

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5.3 Conductors

The power cables shall be of stranded Aluminium / copper round or shaped conductors and control cables shall be of annealed high conductivity stranded copper round conductors. The conductors shall comply with the requirements of IS: 8130.

5.4 Insulation

The conductor insulation shall be XLPE and shall comply with relevant IS.

5.5 Fillers

The cables shall have suitable fillers wherever required, laid up with conductors to provide substantially circular cross section before the inner sheath is applied.

5.6 Inner Sheath

Inner sheath, wherever applicable shall be ST1/ ST2 type compound applied by extrusion process except for paper cables for which it shall be of lead or lead alloy.

5.7 Armouring

All power and control cables shall be armoured. The single core cables shall be armoured with hard drawn Aluminium taps/ wires or any other suitable nonmagnetic material. All other cables shall have galvanized steel wire / strip armouring.

5.8 Outer Sheath

The outer sheath shall be ST1/ ST2 type compound applied by extrusion process and suitable to withstand atmospheric pollution, resistance to termites, fire retardant and coloured black.

5.9 Screening

Screening over conductor and insulation shall be provided as per relevant standard unless specified otherwise. The screening for control cables if specified shall be of aluminium, mylor or equivalent and provided with tinned drain wire which shall be continuous and permanently connected to the screen.

5.10 Identification

The individual cores of cables shall be coloured as per relevant IS. Where it is not possible to distinguish the cores by colour, coloured strip shall be applied on the cores or core nos. shall be marked on each core at regular intervals. All cables shall carry the manufacturer's name or trade mark, the cable size, voltage rating and year of manufacture at intervals not exceeding 100 meters. Running meter markings shall also be provided throughout the length of the cable.

5.11 Dimension

The overall dia. and dia. under armour of the cables shall be indicated by the vendor in the technical particulars. These shall be guaranteed with a tolerance of $\pm 5\%$ but not exceeding 2 mm.



5.12 The cut ends of the cables shall be sealed by means of non-hygroscopic materials.

6.0 SPECIAL PURPOSE CABLES

6.1 Flame Retardant Low Smoke Cables

Flame retardant low smoke cables shall have outer sheath of PVC having following values.

- Minimum oxygen index - 29%
- Minimum temperature index - 250°C

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- Maximum acid gas generation - 20%
- Maximum smoke density rating - 60%

6.2 Heat Resistant Cables

Heat resistant cables shall be of silicon rubber insulated laid circular with asbestos worming and overall glass fibre braided and varnished. Silicon rubber insulating compound shall conform to IS: 6380 and the constructional features shall conform generally to IS: 9968.

7.0 CABLE DRUM



- 7.1 The cables shall be supplied in non-returnable wooden drums (or steel drums if specified) of heavy construction. The wood used for construction of the drums shall be properly seasoned, sound and free from defects.
- 7.2 Cables shall be supplied in specified drum lengths. Where no such indication is given, standard drum lengths may be offered.
- 7.3 The tolerance on each drum of cable shall not exceed $\pm 2.5\%$. However, no negative tolerance on HV cables is acceptable.
- 7.4 All cable drums shall have stencilled data as per relevant IS as well as the purchaser's order no., item no. & drum no.

8.0 TESTS AND INSPECTION

- 8.1 The following tests shall be carried out on the cables as per relevant IS.
- i) Routine Tests - On all cables
 - ii) Acceptance tests - On representative length of each size
 - iii) Type tests - Wherever specified on one cable drum of each size
- 8.2 In addition, the following tests shall be carried out on all fire retardant low smoke cables as per IS or as per the following standards:
- i) Oxygen and temperature index test as per ASTM-D-2863
 - ii) Acid gas emission test as per IEC-754 Part-I
 - iii) Smoke density test as per ASTM-D-2843
 - iv) Flammability test as per IEC-332 Part-I or IS-10810
- 8.3 All the above mentioned tests shall be carried out in the presence of purchaser's representative. In addition, the cables shall be subjected to stage inspection at works and inspection at site for final acceptance.
- 8.4 These tests and inspections shall, however, not absolve the vendor from their responsibility for making good any defect which may be noticed subsequently.

9.0 DRAWINGS AND DOCUMENTS

- 9.1 Drawings and documents as per Annexure-I shall be supplied, unless otherwise specified.
- 9.2 All drawings and documents shall have the following descriptions written boldly.
- Name of client
 - Name of consultant
 - Enquiry / Order Number with plant / project name
 - Code No. and Description

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ANNEXURE - I
DOCUMENTATION FOR CABLES

Sl. No.	Document Description	Documents Required (Y / N)		
		With Bid	For Approval	Final
1.	Specification Sheet	N	Y	Y
2.	Technical Particulars	N	Y	Y
3.	Illustrative and Descriptive catalogues	N	N	Y
4.	Installation, Termination and Jointing Instructions	N	N	Y
5.	Test certificates			
	a) Routine	N	N	Y
	b) Type	N	N	Y
6.	Guarantee Certificates	N	N	Y

Note:

1. 4 hard copies & 1 soft copy shall be supplied for approval after order within 4 weeks from the date of LOI.
2. 8 hard copies & 2 soft copies in CD shall be submitted as final documents prior to despatch of the equipment. These shall be made in sets and supplied in fine plastic coated folder.

Y - Yes, N - No

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TECHNICAL SPECIFICATION

PREFABRICATED LADDER TYPE CABLE RACKS

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4.0	MARKING
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6.0	DRAWINGS AND DOCUMENTS
ANNEXURE - I	DOCUMENTATION FOR PREFABRICATED LADDER TYPE CABLE RACKS

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1.0 SCOPE

- 1.1 This standard covers the technical requirements of design, fabrication, testing at works and delivery in well-packed condition of prefabricated ladder type cable racks.
- 1.2 The standard shall be read in conjunction with Drawing Nos. PDS: E 530 to 538 (9 Sheets).

2.0 STANDARDS TO BE FOLLOWED

- 2.1 The design, manufacture and testing of the cable racks covered by this standard shall comply with the latest issue of following and other relevant Indian Standards, unless otherwise specified. Equipment complying with equivalent IEC standards shall also be acceptable.
- IS: 733 -- Wrought aluminium and aluminium alloy bars, rods and sections for general engineering purposes
- IS: 2629 -- Recommended practice for hot dip galvanising on iron and steel
- IS: 4759 -- Hot dip zinc coatings on structural steel and other allied products
- 2.2 Wherever any requirement, laid down in this standard, differs from that in Indian Standard Specifications, the requirement specified herein shall prevail.

3.0 GENERAL DESIGN AND CONSTRUCTIONAL FEATURES

- 3.1 Ladder type cable racks shall be fabricated as per attached Drawing Nos. PDS: E 530 to PDS: E 538 (9 Sheets).
- 3.2 Cable racks and accessories such as coupler plate, tees, bend, elbows etc. shall be fabricated from 3 mm thick mild steel galvanised sheet or 4 mm thick aluminium 19000 H2 alloy sheet extrusion conforming to designation No. 64430 and condition WP as per IS: 733.
- 3.3 G.I. racks and accessories shall have zinc coating of 800 gm/sq. metre applied by hot dip galvanising process. Galvanising shall be uniform, adherent, smooth and free from defects.
- 3.4 The finished rack and accessories shall be free from sharp edges and corners, burrs and un-evenness. Stepped arrangement of bending is not acceptable. The channel members in the bending shall have uniform curvature and shall be made out of single piece.
- 3.5 The racks shall be supplied in minimum length of 2.4 metre.
- 3.6 Each straight length and bend shall be supplied with two coupling plates fitted at each side channel at one end. The coupling plates shall be supplied with bolts, nuts and washers fitted at the other four holes for fixing to adjoining member.
- 3.7 Coupling plate shall be designed to permit longitudinal adjustment upto ± 10 mm and skew upto 10° .
- 3.8 Clamping arrangement as per attached drawings shall be provided for fixing the rack with the cross support as required.
- 3.9 All the bends, tees and junctions shall be made sufficiently rigid by providing suitable reinforcement on rungs as required.
- 3.10 The rungs shall be connected to the side channels by continuous welding alongwith three sides of rung. Aluminium rack shall be welded by TIG welding process.
- 3.11 All hard wares such as nuts, bolts, washers and crank bolts shall be cadmium plated.

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3.12 Tolerances in various dimension shall be follows:

Length	--	± 5 mm
Width	--	± 2 mm
Height	--	± 1 mm
Bend	--	± 1 mm
Thickness	--	± 0.2 mm

Positive tolerance on total quantity upto ± 5% is acceptable. However, negative tolerance on total quantity is not acceptable.

4.0 MARKING

The packing shall be clearly marked on the outside (on top side & ends) in indelible ink with the following minimum details:

- Part No.
- Size of Tray (Length x Width x Height)
- No. of Tray / Section, Total Weight
- Material Specification
- Client's Name
- Purchase Order No.
- Manufacturer's Name

5.0 TESTS AND INSPECTION

5.1 Following tests shall be carried out on prefabricated cable racks:

Visual inspection and checking for

- i) Quality and thickness of raw material
- ii) Dimensions as per drawing.
- iii) Quality of welding (before galvanising for G.I. racks)
- iv) Preparation of metal surfaces (for G.I. racks).

5.2 After galvanising, G.I. cable racks shall be subjected to following tests as per IS:4759.

- i) Mass of galvanising coating -- At any location the thickness of zinc coating shall not be less than 90 micron. However, average thickness of zinc coating shall not be less than 113 micron.
- ii) Uniformity of galvanising coating.
- iii) Adhesion of galvanising coating.
- iv) 3 samples from each lot shall be taken for testing.
- v) From each lot and size of rack, measure length of 10 trays and average length to be multiplied by number of trays to arrive for total length.

5.3 All the above tests shall be carried out in the manufacturer's works in the presence of Purchaser's representative. In addition to the above tests, the cable racks and its accessories shall be subjected to stage inspection at works and inspection at site for final acceptance.

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5.4 These tests and the Purchaser's inspection shall, however, not absolve the vendor from their responsibility for making good any defect which may be noticed subsequently.

6.0 DRAWINGS AND DOCUMENTS

6.1 Drawings and documents as per Annexure-I shall be supplied, unless otherwise specified.

6.2 All drawings and documents shall have the following descriptions written boldly.

- Name of client
- Name of consultant
- Enquiry / Order Number with plant / project name
- Code No. and Description

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ANNEXURE - I

DOCUMENTATION FOR PRE-FABRICATED LADDER TYPE CABLE RACKS

Sl. No.	Document Description	Documents Required (Y / N)		
		With Bid	For Approval	Final
1.	Illustrative and Descriptive catalogues	N	N	Y
2.	Installation, Termination and Jointing Instructions	N	N	Y
3.	General Arrangement Drawings, showing details of rack, coupling pieces, fasteners, etc.	N	Y	Y
4.	Test certificates	N	N	Y
5.	Guarantee Certificates	N	N	Y

Note:

1. 4 hard copies & 1 soft copy shall be supplied for approval after order within 4 weeks from the date of LOI.
2. 8 hard copies & 2 soft copies in CD shall be submitted as final documents prior to despatch of the equipment. These shall be made in sets and supplied in fine plastic coated folder.

Y - Yes, N - No



TALCHER FERTILIZERS LIMITED
TECHNICAL SPECIFICATION - LOCAL CONTROL STATION

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TECHNICAL SPECIFICATION

LOCAL CONTROL STATION



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1.0 SCOPE

- 1.1 This standard covers the technical requirements of design, manufacture, testing at works and delivery in well-packed condition of Local Control Stations.
- 1.2 This standard shall be read in conjunction with relevant part of Design Philosophy - Electrical and other relevant references as specified therein.

2.0 STANDARDS TO BE FOLLOWED

- 2.1 The design, manufacture and testing of the equipment covered by this standard shall comply with the latest issue of IS/IEC:60947 and other relevant Indian Standards, unless otherwise specified. Equipment complying with equivalent IEC standards shall also be acceptable.
- 2.2 The design and operational features of the equipment offered shall also comply with the provisions of latest issue of the Indian Electricity rules and other relevant statutory Acts and Regulations. The supplier shall, wherever necessary, make suitable modification in the equipment to comply with the above.
- 2.3 Wherever any requirement, laid down in this standard differs from that in Indian Standard Specifications, the requirement specified herein shall prevail.

3.0 SERVICE CONDITIONS

3.1 Ambient Conditions

These shall be as indicated elsewhere in Design Philosophy - Electrical.

3.2 System Details

These shall be as indicated elsewhere in Design Philosophy - Electrical.

4.0 OPERATIONAL REQUIREMENTS

This equipment and associated components shall be suitable for operating satisfactorily under the specified ambient and system conditions.

5.0 GENERAL DESIGN AND CONSTRUCTIONAL FEATURES

- 5.1 The Control Stations shall be suitable for control voltage not exceeding 500V, 50 Hz AC or 220V D.C.
- 5.2 The enclosure shall be of die cast Aluminium alloy LM-6. As an alternative to cast Aluminium, fibre glass enclosure is also acceptable.
- 5.3 The equipment shall have dust, hose and weather proof construction equivalent to IPW-55 as per IS/IEC:60947. These shall be suitable for outdoor location without any additional protection or cover.
- 5.4 A rain-hood shall be offered as an additional item. It shall be made of 14 gauge Aluminium sheet bent to shape. In case of fibre glass enclosure, these can be made of fibre glass.
- 5.5 All external hardware of diameter less than 8 mm shall be of stainless steel and those of diameter 8 mm and above shall be of mild steel cadmium plated or zinc passivated. For fibre glass enclosure Nylon PVC bolts of diameter 8 mm may be used.
- 5.6 The control station shall preferably be with bolted cover. The bolts for retaining the cover in position shall be provided with 10 mm dia. stainless steel and these shall be so arranged that they do not pierce into the door gasket.
- 5.7 All the components shall be mounted on a base plate inside the enclosure. Necessary actuating system for control switch, push button, non yellowing acrylic/ glass cover for

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ammeter and indication lamps shall be provided on the front cover. No wiring shall be carried out on the front cover.

- 5.8 The layout of components in the control station shall be liberal and standardised.
- 5.9 All mating surfaces shall be smoothly machined and shall be of sufficient width of at least 6 mm. The covers shall be provided with continuous gasket made of neoprene or synthetic rubber to prevent ingress of dust and moisture. The gasket shall be held in position in groove provided in the enclosure and shall be pressed all around uniformly by suitably shaped projection of the door. Gaskets simply glued to the surface are not acceptable.
- 5.10 The enclosure shall be suitable for mounting on wall or on steel structure. 4 Nos. holes suitable for 12 mm bolts shall be provided outside the enclosure for fixing the control stations.
- 5.11 The internal wiring shall be carried by means of single core PVC insulated 1.5 sq. mm stranded copper conductor cable. All termination shall be made with crimping type proper size lugs and shall be properly ferruled.
- 5.12 The control stations shall be completely factory wired and ready for external cable connection.
- 5.13 For easy identification, numbering ferrules shall be provided on all wiring at both ends i.e. equipment end and terminal block end. Terminals for external wiring shall be numbered
- 5.14 The enclosure shall be provided with two earthing terminals with studs of 8 mm. dia. projecting outside the enclosure for connection to earth. These terminals shall not pierce through the enclosure and shall be marked with earthing symbol.
- 5.15 Each control station shall be provided with minimum 2 mm thick stainless steel name plates or consisting of black Perspex with white engraving indicating the code number and description of the equipment controlled by it. Similar labels shall be provided for all indication lamps, push buttons and control switches. The name plate and label shall be fixed with screws only.

6.0 SPECIAL FEATURES FOR FLAME PROOF LOCAL CONTROL STATION

- 6.1 The enclosure shall be in addition, of flameproof execution as per IS: 2148.
- 6.2 The control stations shall be suitable for hazardous area of enclosure group and temperature class as indicated in Design Philosophy - Electrical.
- 6.3 Cables shall enter the terminal box through flame proof cable gland. From the terminal chamber to the main enclosure, the connections shall be made through proper bushings. Direct entry of external cables into the main enclosure shall not be accepted. All entries shall be provided with stainless steel inserts.
- 6.4 An additional earthing terminal inside the terminal chamber shall be provided.
- 6.5 Local control stations and cable gland must be certified by the Central Mining Research Institute, Dhanbad or any other statutory authority for use in the specified hazardous area.

7.0 COMPONENT DETAILS

7.1 Trip-Neutral-Close Switch

TRIP-NEUTRAL-CLOSE switch shall be double pole, 3 position, pistol grip, rotary type having self spring return feature to neutral position. The contacts shall be of phosphor bronze and shall be provided with two breaks in series. Mechanical sequence device to prevent two successive movements to the same position shall be fitted. The switch shall be capable of being padlocked in the 'TRIP' position.

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- 7.2 **‘Auto-Manual’ Switch**
‘Auto-Manual’ switch shall be single pole stay put type having three positions “AUTO-OFF-MANUAL”. Provision shall be made to padlock the switch in the “OFF” position.
- 7.3 **Selector Switch / Lock Service Switch**
These shall be single pole stay put type having two position with a pistol grip handle and capable of being padlocked in one of the position.
- 7.4 All the switches shall be rotary type with snap or wiping action contact and having a set of normally open and closed contacts in each position. All switches shall be provided with pistol grip handle.
- 7.5 **‘Off-Auto-On’ Switch**
- 7.5.1 ‘OFF-AUTO-ON’ switch shall be in minimum three stack configuration, each stack having three positions with spring return from ‘ON’ to ‘Auto’ position and lockable in ‘OFF’ position by means of padlock.
- 7.5.2 The switch shall have sliding contact between ‘AUTO’ and ‘ON’ position. In ‘OFF’ position the contact shall be completely broken from ‘AUTO’ position.
- 7.6 **Push Buttons**
These shall be spring loaded, with a set of normally closed and open contacts. The push buttons for ‘start’ shall be shrouded type and coloured green while ‘stop’ push buttons shall be un-shrouded type and coloured red. Provision shall be made to padlock the ‘stop’ push button in ‘OFF’ position. The fixing ring shall be metallic white. An oil proof rubber cap shall preferably be provided.
- 7.7 The switches and push buttons shall conform to utilization category AC11/ DC11 as per IS/IEC:60947. The contact shall be rated to make, break and carry inductive current of 5 Amp. at 415 V AC and 1 Amp of 220V DC. The contact arrangement shall be as shown in the terminal drawings. Built in locks instead of padlocking are not acceptable.
- 7.8 **Indication Lamps**
- 7.8.1 LED type indication lamps shall be provided to indicate the various circuit conditions as shown in the terminal drawings.
- 7.8.2 The LEDs shall provide good illumination through a viewing angle of 180°. The LEDs shall have lumen output of 200 milli Candella in the axial direction.
- 7.8.3 The colour of the LED indication for various functions shall be as follows:-
- RED : For ‘ON’ Indication
GREEN : For ‘OFF’ Indication
WHITE : For “Ready for Service” Indication
- 7.9 **A.C. Ammeters**
The ammeter shall be flush mounting, moving iron spring controlled type, of accuracy class 1.5 as per IS:1248, with square face of minimum size 72 mm x 72 mm having scale range 0-240°. The ammeter shall be provided with uniform scale up to CT primary current and compressed end scale up to 6 times the CT primary current. Adjustable red pointer shall be provided to indicate the full load current of the motors. Zero adjusters shall be provided for operation from the front of the meter. All ammeters shall be operated through 1Amp. CTs only.

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7.10 **D.C. Ammeters**

The D.C. ammeter shall be shunt operated. These shall be moving coil or moving iron type of accuracy class 1.5 as per IS: 1248.

7.11 **Terminal Blocks**

All control stations shall be provided with terminal blocks. Terminal blocks shall be located at a minimum distance of 50 mm from the bottom of the enclosure. The terminal blocks for the control station shall be suitable for conductor sizes of 2.5 mm². These shall be of pressure clamp type design mounted on the base channel. The minimum rating of terminal block shall be 16 Amp.

7.12 **Cable Glands**

The cables for the external connections, shall enter the terminal chamber through heavy duty double compression type rolled Aluminium cable glands suitable for 2.5 sq. mm PVC insulated, armoured, and PVC sheathed copper conductor 1.1 KV grade cables. The number and cores of control cables shall be as per requirement. The cable gland shall be fitted in a threaded hole.

8.0 PAINTING

8.1 The enclosure after suitable pre-treatment shall be painted with two coats of anti-rust paint followed by two coats of anticorrosive paint.

8.2 Epoxy based paint shall be used.

8.3 All paints shall be carefully selected to withstand tropical heat and extremes of weather. The paint shall not scale off, crinkle or be removed by abrasion due to normal handling.

8.4 Unless otherwise specified, the finishing shade shall be of light grey having shade no. 631 as per IS: 5.

9.0 TESTS AND INSPECTION

9.1 All equipment shall be routine tested as per relevant standards.

9.2 Additional tests, wherever specified, shall be carried out.

9.3 All the above mentioned tests shall be carried out in the presence of purchaser's representative. In addition, the equipment shall be subjected to stage inspection at works and inspection at site for final acceptance.

9.4 These inspections shall, however, not absolve the vendor from their responsibility for making good any defect which may be noticed subsequently.

10.0 DRAWINGS AND DOCUMENTS

10.1 Drawings and documents as per Annexure-I shall be supplied, unless otherwise specified.

10.2 All drawings and documents shall have the following descriptions written boldly.

- Name of client
- Name of consultant
- Enquiry / Order Number with plant / project name
- Code No. and Description

11.0 SPARES

11.1 Commissioning Spares : Commissioning spares, as required, shall be supplied with the main equipment. Item-wise list of recommended commissioning spares shall be furnished for information.

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- 11.2 Spares for 2 Years Operation (Mandatory), as specified shall be supplied.
- 11.3 List of Recommend Spares (other than Mandatory Spares) alongwith recommended quantity and item-wise price shall be furnished.
- 11.4 All spare parts shall be identical to the parts used in the equipment.

12.0 PACKING

- 12.1 The local control stations shall be properly packed to safeguard against weather conditions and handling during transit. It shall be wrapped in polythene bags and an additional wrapping of bitumen paper shall also be provided to make it completely water proof before the equipment is packed in wooden crates.
- 12.2 The packing box shall contain a copy of the installation, operation and maintenance manual.



ANNEXURE - I

DOCUMENTATION FOR LOCAL CONTROL STATIONS

Sl. No.	Document Description	Documents Required (Y / N)		
		With Bid	For Approval	Final
1.	Specification Sheet	N	Y	Y
2.	Technical Particulars	N	Y	Y
3.	General Arrangement Drawings	N	Y	Y
4.	Schematic Diagrams	N	Y	Y
5.	Illustrative and Descriptive catalogues	N	N	Y
6.	Catalogues of bought out accessories	N	N	Y
7.	Spare parts list	N	N	Y
8.	Installation, Operation and Maintenance manual	N	N	Y
9.	Test certificates			
	a) Routine	N	N	Y
	b) Type (only for flameproof equipment)	N	N	Y
	c) For enclosure	N	N	Y
10.	Guarantee Certificates	N	N	Y

Note:

1. 4 hard copies & 1 soft copy shall be supplied for approval after order within 4 weeks from the date of LOI.
2. 8 hard copies & 2 soft copies in CD shall be submitted as final documents prior to despatch of the equipment. These shall be made in sets and supplied in fine plastic coated folder.



Y - Yes, N - No

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TECHNICAL SPECIFICATION

JUNCTION BOX

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1.0 SCOPE

- 1.1 This standard covers the technical requirements of design, manufacture, testing and inspection at works and delivery in well packed condition of junction boxes.
- 1.2 This standard shall be read in conjunction with relevant part of Design Philosophy - Electrical and other relevant references as specified their in.

2.0 STANDARDS TO BE FOLLOWED

- 2.1 The design, manufacture and testing of the equipment covered by this standard shall comply with the latest issue of relevant Indian standards unless otherwise specified. Equipment complying with equivalent IEC standards shall also be acceptable.
- 2.2 Flameproof & increased safety junction boxes shall in addition, comply with the requirement as laid down in IS: 2148 & IS: 6381 respectively.
- 2.3 The design and constructional features of the junction boxes offered shall also comply with the provision of latest issue of the Indian Electricity Rules and other relevant Statutory Rules & Regulations. The supplier shall, whenever necessary, make suitable modification in the equipment to comply with the above mentioned rules.
- 2.4 Wherever any requirement laid down in this standard differs from that in Indian Standard specifications, the requirement specified herein shall prevail.

3.0 SERVICE CONDITIONS

3.1 Ambient Conditions


These shall be as indicated in Design Philosophy - Electrical.

3.2 System Details

The details of power supply system shall be as indicated in Design Philosophy – Electrical.


4.0 GENERAL DESIGN & CONSTRUCTIONAL FEATURES

- 4.1 The junction boxes shall be dust and weather proof and suitable for installation outdoors without extra protection. The degree of protection shall be IP-55 as per IS/IEC:60529.
- 4.2 The junction boxes shall be of die cast aluminium alloy LM-6 with domed / suspension covers.
- 4.3 The casting of the junction boxes and their cover shall be pressure die cast. The casting shall be uniform and free from blow holes. All mechanical surfaces shall be free from burrs, dents and internal roughness.
- 4.4 All external hardware of diameter less than 8 mm shall be of stainless steel and those of diameter 8 mm and above shall be of mild steel cadmium plated or zinc passivated. For fibre glass enclosure Nylon PVC bolts of diameter 8 mm may be used.
- 4.5 The clearances and creepage distances shall be maintained inside the junction boxes as per relevant Indian standard.
- 4.6 The junction boxes shall be suitable for wall / structure / ceiling mounting and necessary arrangement for mounting the same shall be provided.
- 4.7 The junction boxes shall be provided with continuous gasket made of neoprene or synthetic rubber to prevent ingress of dust. The gasket shall be held in position in groove provided in the enclosure and shall be pressed all around uniformly by suitably shaped projection of the door. Gaskets simply glued to the surface are not acceptable.
- 4.8 The junction boxes housing terminal block shall be moulded type made of DMC / Fibre glass. Threaded terminals shall be made of brass (nickel plated or tinned) and provided

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with two tightening threaded nuts and four washers all made of brass (nickel plated or tinned). The terminals shall have two shorting links each horizontally placed connecting three terminals.

- 4.9 The terminal block shall be fitted with junction boxes base by means of 2 nos. 1/2" long nickel plated brass screws.
- 4.10 The junction boxes shall be provided with two nos. external earthing terminals and 1 no. internal earthing terminal.
- 4.11 All live parts inside the junction boxes shall be insulated and shall withstand a test voltage of 2.5 KV for 1 minute.
- 4.12 The junction boxes shall be provided with heavy duty double compression type rolled Al cable glands to suit the cable entries.
- 4.13 Threaded blanking plugs shall be provided for junction boxes to plug out the entries not in use as indicated in bill of quantities enclosed.
- 4.14 The junction boxes shall be provided with a blank stainless steel tag plate fastened to the junction box top cover with two stainless steel screws. The plate shall be at least 25 mm wide, 100 mm long and 1 mm thick.
- 4.15 For flameproof / increased safety junction boxes, the manufacturer shall submit copies of test certificates from statutory authorities clearly stating that the junction boxes as well as cable glands / blanking plugs are suitable for hazardous area.
- 4.16 **15 Amp. Junction Box**
- 4.16.1 The junction boxes shall be 4 way dome cover type.
- 4.16.2 The dimensions of the junction boxes with their cover and accessories shall be generally as per PDS: E-547.
- 4.16.3 The junction boxes housing terminal block shall be moulded type made of DMC / Fibre glass as per Drg. no. PDS: E-557.
- 4.17 **63 Amp. Junction Box**
- 4.17.1 The junction boxes shall be 3 / 4 way dome cover type.
- 4.17.2 The minimum internal diameter of the box shall be 240 mm.
- 5.0 **SPECIAL FEATURES FOR JUNCTION BOXES FOR HAZARDOUS AREA**
- 5.1 For increased safety junction boxes, the terminals shall be provided with positive locking device against loosening.
- 5.2 The enclosure shall be in addition, of increased safety execution, Exe, as per relevant standard and shall be suitable for installation in classified hazardous area.
- 5.3 The junction boxes shall be liberally dimensioned in order to avoid temperature rise inside the enclosure which may damage the insulating materials or gaskets employed therein.
- 5.4 Cables shall enter the terminal box through increased safety compression type cable glands. From the terminal chamber to the main enclosure, the connections shall be made through proper bushings.
- 5.5 An additional earthing terminal inside the terminal chamber shall be provided.
- 5.6 The junction boxes shall be provided with Brass-Nickel plated shorted links. The terminal block shall be made of non-hygroscopic compound. Bakelite / Hylam shall not acceptable.
- 5.7 All screws / bolts and nuts shall be of stainless steel.

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- 5.8 Junction boxes and cable glands must be certified by Statutory Authorities for use in the specified hazardous area. Equipments certified by overseas authorities shall obtain certificate of compliance / letter of opinion from respective statutory authorities.
- 5.9 Type Test certificates for increased safety type junction boxes and cable glands along with blanking plugs shall be supplied.
- 6.0 **PAINTING**
- 6.1 Epoxy based electrostatic powder coating paint shall be provided on exterior surface while the interior of junction boxes shall be painted with anti-condensate paint. The painting shall be able to withstand corrosive atmosphere.
- 6.2 Unless otherwise specified, the finishing shade shall be grey having shade no. 632 as per IS-5.
- 6.3 The terminal block of junction boxes shall be painted with Red, Yellow, Blue & Black colour for phase indication.
- 7.0 **TESTS AND INSPECTION**
- 7.1 The junction boxes shall be routine tested as per relevant standards.
- 7.2 Additional tests, wherever specified, shall be carried out on one unit of each rating.
- 7.3 The procedure & extent of the physical checks, routine & type test shall be governed by Quality Assurance Plan mutually agreed and approved by Inspection Authority.
- 7.4 All the above mentioned tests shall be carried out in the presence of purchaser's representative. In addition, the equipment shall be subjected to stage inspection at works and inspection at site for final acceptance.
- 7.5 These inspections shall, however, not absolve the vendor from their responsibility for making good any defect which may be noticed subsequently.
- 8.0 **PACKING**
Each junction box and cable gland shall be suitably packed and protected from damage due to transportation, loading and unloading. Threaded fittings shall have plastic caps to protect the threading.
- 9.0 **DRAWINGS AND DOCUMENTS**
- 9.1 Drawings and documents as per Annexure-I shall be supplied, unless otherwise specified.
- 9.2 All drawings and documents shall have the following descriptions written boldly:
- Name of client
 - Name of consultant
 - Enquiry / order number with plant / project name
 - Motor Code No. and Description
- 10.0 **SPARES**
- 10.1 Commissioning Spares : Commissioning spares, as required, shall be supplied with the main equipment. Item-wise list of recommended commissioning spares shall be furnished for information.
- 10.2 Spares for 2 Years Operation (Mandatory), as specified shall be supplied.
- 10.3 List of Recommend Spares (other than Mandatory Spares) alongwith recommended quantity and item-wise price shall be furnished.
- 10.4 All spare parts shall be identical to the parts used in the equipment.

ANNEXURE - I



DOCUMENTATION FOR JUNCTION BOXES

Sl. No.	Document Description	Documents Required (Y / N)		
		With Bid	For Approval	Final
1.	Specification Sheet	N	Y	Y
2.	Technical Particulars	N	Y	Y
3.	Certified dimensional drawing, including mounting details	N	Y	Y
4.	Drawing showing constructional details	N	Y	Y
5.	Illustrative and Descriptive catalogues	N	N	Y
6.	Spare parts list	N	N	Y
7.	FLP/Exe certificates for junction boxes and terminals conforming to IEC/ISS (CMRI, CCE, DGFASLI and BARC for terminals)	N	N	Y
8.	Certificate for weather proof construction for junction boxes as per IPW-55	N	N	Y

Note:

1. 4 hard copies & 1 soft copy shall be supplied for approval after order within 4 weeks from the date of LOI.
2. 8 hard copies & 2 soft copies in CD shall be submitted as final documents prior to despatch of the equipment. These shall be made in sets and supplied in fine plastic coated folder.

Y - Yes, N - No

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TECHNICAL SPECIFICATION

ELECTRICALS FOR OVERHEAD CRANES & HOISTS

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1.0 SCOPE

- 1.1 This standard covers the technical requirements of design, engineering, manufacture, testing at works, supply at site, erection, site testing and commissioning of the complete electrical equipment and accessories as required for the overhead travelling crane and hoists.
- 1.2 This standard shall be read in conjunction with relevant mechanical specifications, other relevant standards / specifications.
- 1.3 The scope of work shall include but not limited to the following items:
- i) Drive motors
 - ii) Starting resistors (in case of slip ring motors)
 - iii) Power control panel
 - iv) Control stations
 - v) Limit switches
 - vi) Electromagnetic brakes
 - vii) Power and control cables with accessories
 - viii) Earthing of all equipment
 - ix) All other items, not specified but, required for safe and proper operation
- 1.4 The owner shall provide one no. medium voltage feeder for each crane / hoist and terminate the feeder cable in an isolator located at one end of the bay at a height of 1.5 m from the operating floor. The vendor shall indicate the exact power requirement (running and peak) to enable the owner to size and provide the power supply feeder.
- 1.5 Further distribution of power from this isolator onwards shall be in the vendor's scope.

2.0 STANDARDS TO BE FOLLOWED

- 2.1 The design, manufacture, testing and installation of the equipment shall comply with the latest issue of IS-6547, IS-807 and other relevant Indian Standard specifications and codes of practices. Equipment complying with equivalent IEC standards shall also be acceptable.
- 2.2 The equipment and installation shall also comply with the provisions of latest issue of Indian Electricity rules and other statutory acts and regulations.
- 2.3 Wherever any requirement, laid down in this standard, differs from that in Indian Standard Specification, the requirement specified here-in shall prevail.

3.0 SERVICE CONDITIONS

3.1 Ambient Conditions

These shall be as indicated in Design Philosophy - Electrical.

3.2 System Details

These shall be as indicated in Design Philosophy - Electrical.

- 3.3 The owner shall provide only three phase power at the specified medium voltage. For lighting, control and plug supply the vendor shall provide necessary single phase step-down transformers.

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3.4 All the electrical equipment shall be so designed that enable the crane / hoist to operate at its rated capacity and specified duty cycle with the system variation under the ambient conditions without exceeding the permissible temperature rise and without any detrimental effect on any part.

4.0 GENERAL DESIGN AND CONSTRUCTIONAL REQUIREMENTS

4.1 The electrical system and installation shall be designed as per latest practice to provide maximum reliability, flexibility, safety to personnel and equipment and ease of operation and maintenance.

4.2 All equipment shall have adequate and standard ratings as per ISS.

4.3 All electrical equipment to be located in indoor plant area shall be enclosed in dust, damp and vermin proof enclosure equivalent to IP-54 as per IS/IEC:60529.

4.4 Equipment to be located outdoor shall be weather proof and have IPW-55 protection as per IS/IEC:60529 and shall also be provided with canopy as far as practicable.

4.5 The equipment to be located in hazardous area shall have additional protection as follows:

- a) Zone – I All the equipment shall be in flameproof execution.
- b) Zone – II The equipment producing sparks under normal operation shall be in flameproof execution and others shall be in increased safety execution.

The equipment shall be suitable for the enclosure group and temperature class as indicated in Design Philosophy - Electrical. The equipment selected shall conform to relevant Indian Standard Specification and must be certified by Central Mining Research Institute, Dhanbad or any other statutory authority for use in the specified hazardous area.

4.6 The pendant push button shall be light weight enclosure of aluminium/ polypropylene etc. In case of hazardous areas, the loop between the pendant push button and the crane control panel shall be made intrinsically safe by using suitable isolators. Alternatively certified flame proof components and increased safety terminals can be housed in the hose proof aluminium / polypropylene enclosure.

4.7 Special care shall be taken to ensure that the parts to be opened for inspection and maintenance retain their dust tightness even after repeated opening and closing operations.

4.8 All mating surfaces shall be properly machined. Neoprene gaskets shall be used for dust and weather proofing. The gaskets shall be without any discontinuity.

4.9 Only non-hygroscopic materials shall be used for insulation. All insulation shall be specially impregnated to withstand ambient conditions and atmospheric pollution.

4.10 All live parts shall be adequately protected to prevent inadvertent or accidental contact.

4.11 The minimum clearance and creepage distance of M.V. equipment shall be 20 and 28 mm respectively and shall be positively maintained after connections.

4.12 All external hardware of diameter less than 8 mm shall be of stainless steel and those of diameter 8 mm and above shall be of mild steel cadmium plated or zinc passivated.

4.13 Earthing terminals complete with sockets and identification marks shall be provided on the enclosure of all electrical equipment. The number of terminals shall be two for equipment rated above 240V and one for those rated 240V and below. Additional internal earthing arrangement shall be provided for flameproof equipment.

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- 4.14 All equipment shall be provided with stainless steel name plates containing the particulars as per relevant IS along with the description and code nos. of equipment
- 4.15 All the electrical equipment shall be provided with separate terminal box, heavy duty double compression type rolled aluminium cable glands, proper crimping lugs and anti-vibration type terminals suitable for the cable sizes required.
- 4.16 Enclosure for limit switches, pendant push button, junction boxes and magnets etc. shall be of cast aluminium. Enclosure for control panel, transformer and resistors may be of sheet steel. The thickness of the sheet steel for the enclosure shall not be less than 2.5 mm. All enclosures shall be suitably painted to withstand atmospheric pollution as mentioned in the Design Philosophy - Electrical.
- 4.17 The doors or inspection covers shall be provided with threaded knobs or butterfly nuts made of plated carbon steel. Copper or copper alloys shall not be used outside the enclosures.
- 4.18 To facilitate maintenance and testing of all electrical equipment:
- a) Disconnecting links shall be provided where necessary.
 - b) All cable lugs and terminals shall be numbered in a permanent form corresponding to the wiring diagram.
 - c) Easy access and adequate working space shall be provided around all motors, panels, limit switches etc. safety railing shall be provided, where necessary.

5.0 EQUIPMENT SPECIFICATION

5.1 Power Connection

- 5.1.1 The main supply shall be obtained by flexible cable or otherwise as per requirement.
- 5.1.2 In case of overhead bare conductors, they shall be of copper and mounted on side of the crane bridge. Four number of gunmetal type current collector with renewable carbon inserts shall be used for power connection. One end of the bare conductor shall be connected to the owner's isolator by means of fixed cable.
- 5.1.3 In case of flexible cable arrangement, the cable shall be connected at one end of the crane and the other end to owner's isolator. The cable shall be hung at intervals by festooned type arrangement.
- 5.1.4 In either case the power fed to the trolley shall be by means of flexible cables fixed and supported by festooned arrangement.
- 5.1.5 The arrangement of fixing and supporting the flexible cables shall be such that the cable is not damaged due to repeated travelling of the crane and trolley. Supporting G.I. wire shall be provided, wherever required.
- 5.1.6 The collector rollers and shoes shall be designed to avoid sparking.

5.2 Power Control Panel

- 5.2.1 The panel shall house all the necessary electrical equipment for distribution of power and control of individual equipment / circuit.
- 5.2.2 The panel shall be totally enclosed, floor mounting, dead front, free standing type in cubicle construction.
- 5.2.3 The panel shall house the following:
- i) For incoming supply
 - Triple pole switch fuse units
 - Supply 'ON' signal lamps (LED Type)

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The above switch shall cut off all power driven and associated equipment on the crane except lighting and plug supply circuits.

- ii) For motors
 - Reversing type starter with necessary contactors and timers.
 - Other controlling relays and devices.
- iii) For lighting, control and plug supply
 - Single phase transformers
 - Isolating switch fuse units on primary and secondary sides.

5.2.4 All switches shall be motor duty type (AC 23) and rated for 1.5 times of the full load current of the circuit. The incoming switch shall be interlocked with the panel door.

5.2.5 All contactors shall be air break type and of AC4 utilization categories. The thermal rating of the contactor shall be 1.5 times the full load current of the circuit.

5.2.6 The power contactors shall be interlocked electrically and mechanically so that there shall be no possibility of simultaneous operation of two contactors for the same motor.

5.2.7 Electrical interlock shall be provided between main hoist and micro hoist motors.

5.2.8 All thermal overload relays shall have in-built single phasing feature and ambient compensated, separately mounting and hand reset type. The reset push bottom for thermal overload relays shall be provided on the cover of the control panel so that it is possible to reset the relay from outside without opening the cover of the panel. Also indication shall be provided for hoisting/travel motors tripping on overload.

5.2.9 The panel shall be installed on properly levelled base frame fabricated out of channels of suitable size.

5.3 Motors

5.3.1 The design and specification of all motors shall comply with requirements stated elsewhere in the specifications.

5.3.2 The power rating of the motors shall be 25% higher than the design requirement of the driven equipment, under the specified service and duty conditions.

5.3.3 All motors shall preferably be of squirrel cage type and so designed that smooth acceleration or deceleration of the load is possible without any jerks. Further a maximum displacement of 2 mm when starting and stopping the motor in quick succession shall be guaranteed.

5.3.4 The motors for main hoist and micro hoist shall be suitable for intermittent duty type S4 with 60% C.D.E. and 300 starts / stops per hour. The motors for long travel and cross travel shall be suitable for S2 duty for 60 minutes.

5.3.5 The motors shall be so located that all parts are accessible for inspection and maintenance without affecting normal ventilation.

5.4 Brakes

5.4.1 The brakes for each motor shall be suitable for duties as specified below:

- a) Main / Micro hoist S4 duty
- b) Long / cross travel S2 duty

5.4.2 The coil of the brake shall be wound with fibre glass covered annealed copper conductor suitable for class H application. An additional covering with glass taps shall

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be provided over the coil. The maximum temperature of the coil for continuous operation shall be limited to 140° C. The coil shall be vacuum impregnated.

5.4.3 For other design details refer mechanical engineering standard.

5.5 **Limit Switches**

5.5.1 Limit switches of both shunt and series type shall be used in control and power circuit.

5.5.2 These shall be heavy duty type and of sturdy construction in cast aluminium enclosure.

5.5.3 The mode of operation of these limit switches shall be positive and direct acting type.

5.5.4 The contacts shall be rated 50% more than the required current ratings.

5.5.5 The width of the roller of limit switches shall be sufficient to avoid slippage of contact with the striker.

5.5.6 The striker provided for operating these limit switches shall have rubber padding on surface which will make contact with roller to actuate it. The limit switches and its roller should be designed to withstand the frequent impact pressure.

5.5.7 Switches in which the contacts are operated by spring or gravity or both on the withdrawal of a chain or similar devices, shall not be used.

5.6 **Transformers**

5.6.1 These shall be of dry type, class H insulated, air cooled, double wound and mounted inside the panel.

5.6.2 The transformers shall be provided with switch fuse unit on their primary side of suitable rating. One side of secondary windings of the transformers shall be earthed and other shall be provided with fuse of suitable rating.

5.7 The rating of the transformers shall be at least 2.5 times the continuous load.

5.8 **Junction Box**

5.9 Junction boxes shall be of cast aluminium construction and adequately sized to enable easy termination of cables.

5.10 **Hand Lamps**

5.10.1 Provision shall be made in the crane for use of hand lamps by installing 2 nos. 24 volts, 2 pin metal clad switch sockets. One of the sockets shall be on the bridge (outside the panel) and the other on the trolley.

5.10.2 The transformer primary and secondary voltage shall be 250V and 25V respectively.

6.0 **CABLES, CABLE TERMINATION AND CONNECTIONS**

6.1 The cables used for fixed wiring shall be 1.1 KV grade PVC insulated armoured and PVC sheathed overall, and shall conform to IS: 1554 Part-I.

6.2 The flexible cable used for power supply to crane and also for interconnection of equipment mounted on moving and fixed part of the crane shall be 1.1 KV grade heavy duty type.

6.3 All cables shall be properly laid and supported with adequately sized aluminium clamps at 500 mm interval.

6.4 Cable entry on all electrical equipment e.g. panels, motors, limit switches, brakes, junction boxes etc. shall be through double compression type rolled aluminium cable glands.

6.5 The internal power wiring of panels shall be carried out by PVC insulated stranded copper flexible cable.

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- 6.6 The wiring shall be arranged in a neat fashion and supported on PVC channel or PVC stand of screw support.
- 6.7 For equipment mounted on the doors, the wiring shall be carried out with flexible stranded copper cables in such a way that no strain is put on the wires and equipment when the door is opened for inspection and maintenance.
- 6.8 External looping of wires shall be done through separate dust tight junction boxes.
- 6.9 The sizes of power cables to be used shall be subject to owner's approval. The minimum size of power and control cables shall be 16 sq. mm (Al) & 2.5 sq. mm (Cu) respectively.

7.0 EARTHING

- 7.1 The earthing of all electrical equipment shall be carried out in accordance with IS: 3043.
- 7.2 The enclosures of electrical equipment shall be connected to an aluminium earth ring on the crane which in turn shall have effective electrical connection with the bridge.
- 7.3 The crane bridge shall be earthed through the bridge travel runway rails on both sides which in turn shall be earthed to owner's earth ring located on the ground floor.
- 7.4 Further the power supply cable for the crane shall have an additional conductor for earth connection. Both sides of this conductor shall be earthed.
- 7.5 All earth conductors shall be of aluminium.
- 7.6 This size of earth conductor shall be equal to half the size of the power conductor subject to a minimum size of 10 sq. mm.

8.0 CONTROL DESK / CONTROL STATION

- 8.1 The crane shall be controlled either from the floor by means of a pendant control station or from bridge mounted control desk as indicated in the mechanical data sheet.
- 8.2 In either case, the units shall have the following control devices:
- Main off push button with padlocking arrangement.
 - Indication lamps for supply 'ON'
 - Control push buttons, as specified in the mechanical data sheet.
 - All other devices required for safe and proper operation of the crane / hoist.
- 8.3 All push buttons shall be momentary contact type, coloured as per IS: 6875 and have 1 NO and 1 NC contacts.
- 8.4 The bridge mounted control desk, where specified, shall be of totally enclosed and dust tight construction. All controlling equipment shall be mounted on the top. It shall be located at most convenient location to allow movement of the operator. The installation shall be equipped with adjustable chair, fan, light and main isolating switch.
- 8.5 The pendant control station, where specified, shall be in a single enclosure and in totally enclosed dust light execution. The unit shall be suspended and supported from the bridge platform by flexible steel wire rope. The connection shall be made with a multi core flexible copper conductor cable and shall have 20% spare cores. One core shall be provided for earth connection of the circuit.

9.0 PAINTING

Enclosures of all electrical equipment shall be painted with two coats of epoxy based primers after suitable pre-treatment. Two coats epoxy based paint of approved colour shall be provided.

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10.0 TESTS AND INSPECTION

- 10.1 All equipment shall be routine tested as per relevant Indian Standard Specifications.
- 10.2 Additional tests, wherever specified, shall be carried out on one equipment of each rating.
- 10.3 All the above mentioned tests shall be carried out in presence of owner's representative.
- 10.4 The owner's inspection shall, however, not absolve the vendor from his responsibility for making good any defects which may be noticed subsequently.
- 10.5 Despatch of materials shall be subject to written consent of owner or his representative.

11.0 INSTALLATION, TESTING AND COMMISSIONING

- 11.1 The vendor shall undertake installation of all electrical equipment in accordance with latest code of practices, in conformity with recommendation of the respective equipment manufacturer, drawings approved by the owner or owner's representative, direction of Engineer-in-charge, statutory regulations and to the entire satisfaction of the owner.
- 11.2 The vendor shall arrange all the necessary erection tools and tackles, testing and measuring instruments and shall supply the required erection materials including structural steel.
- 11.3 Following tests shall be specifically conducted before commissioning in presence of owner's representative. All the test results shall be recorded and submitted to the owner.
- i) Insulation test.
 - ii) Continuity test.
 - iii) High voltage test.
 - iv) Simulation test.

12.0 DRAWINGS AND DOCUMENTS

- 12.1 Drawings and documents as per Annexure-I shall be supplied unless otherwise specified.
- 12.2 All drawings and documents shall have the following description written boldly :
- Name of client
 - Name of consultant
 - Enquiry / Order Number with plant / project name
 - Code No. and Description

13.0 SPARES

- 13.1 Commissioning Spares : Commissioning spares, as required, shall be supplied with the main equipment. Item-wise list of recommended commissioning spares shall be furnished for information.
- 13.2 Spares for 2 Years Operation (Mandatory), as specified shall be supplied.
- 13.3 List of Recommend Spares (other than Mandatory Spares) alongwith recommended quantity and item-wise price shall be furnished.
- 13.4 All spare parts shall be identical to the parts used in the equipment.

ANNEXURE - I

DOCUMENTATION FOR ELECTRICALS FOR OVERHEAD CRANES & HOISTS

Sl. No.	Description	Documents Required (Y / N)		
		With Bid	For Approval	Final
1.	Specification sheet and technical particulars	N	Y	Y
2.	Composite schematic diagram	N	Y	Y
3.	Dimensional drawing showing the mounting details and general arrangement for the following equipment			
	a) Motors	N	Y	Y
	b) Power control panel	N	Y	Y
	c) Control station	N	Y	Y
	d) Limit switches etc.	N	Y	Y
4.	Down shop lead and power supply arrangement with civil scope.	N	Y	Y
5.	Inter-connection with terminal diagram and cable details	N	Y	Y
6.	Operating and maintenance instruction manual	N	N	Y
7.	Catalogues of bought out items	N	N	Y
8.	Test certificates	N	N	Y

Note:

- 4 hard copies & 1 soft copy shall be supplied for approval after order within 4 weeks from the date of LOI.
- 8 hard copies & 2 soft copies in CD shall be submitted as final documents prior to despatch of the equipment. These shall be made in sets and supplied in fine plastic coated folder.


Y - Yes, N - No

- The tenderer shall also quote for any other spares as deemed necessary to be kept in stock for stipulated time.

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TECHNICAL SPECIFICATION

HIGH VOLTAGE VARIABLE FREQUENCY DRIVE SYSTEM

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1.0 SCOPE

- 1.1 The scope of this specification is to define the minimum technical requirements for the design, manufacture, testing and supply of High Voltage, AC Variable Frequency Drive system. The VFD system shall be complete with Squirrel Cage Induction Motor/ Synchronous Motor as specified in data sheet, Converter, Converter input transformer, drive output transformer, DC link reactor with associated auxiliaries, harmonic filters and field mounted local motor control panel.
- 1.2 The Vendor shall be responsible for engineering and functioning of the complete system, meeting the intent and requirement of this specification and data sheets. This shall include but not be limited to inverter sizing, transformer sizing, transformer impedance selection, vector group, input and output harmonic filter design and sizing, output dv/dt filter sizing, motor cable selection and motor sizing/selection.
- 1.3 This specification applies to drive systems having converter input voltage above 1000 V AC and up to and including 11000V AC.

2.0 CODES AND STANDARDS

- 2.1 The equipment shall comply with the requirements of latest revision of the following standards issued by BIS, unless otherwise specified:

IS:325	Three-phase Induction Motors
IS:3700	Essential Ratings and Characteristics of Semiconductor Devices
IS:3715	Letter symbols for semi-conducting devices
IS:4411	Code of designation of semi-conducting devices
IS:5001	Guide for preparation of drawings of semiconductor devices and Integrated Circuits
IS:5469	Code of practice for the use of semiconductor Junction Devices
IS:14901	Semi-conductor devices- Discrete devices & Integrated Circuits
IS:15880	Three Phase Cage Induction motors when fed from IGBT Converters Application Guide
IS:8789	Values of Performance characteristics for Three Phase induction motor
IS: 12615	Energy Efficient Induction Motors - Three Phase Squirrel Cage
IS:12729	Common specification for High-Voltage Switchgear and Control gear standards
IEC:60 146-1-3	Semiconductor Convertors general requirements and line commutated convertors- Transformer & reactors
IEC:61800	Adjustable speed electrical power drive systems
IEEE:519	Recommended Practices and requirements for Harmonics Control in Electrical power system

- 2.2 In case of imported equipment, standards of the country of origin shall be applicable, if these standards are equivalent or stringent than the applicable Indian standards.
- 2.3 The equipment shall also conform to the provisions of Indian Electricity rules and other statutory regulations currently in force in the country.

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2.4 In case Indian standards are not available for any equipment, standards issued by IEC/BSNDE/IEEE/NEMA or equivalent agency shall be applicable.

2.5 In case of any contradiction between various referred standards/specifications/data sheet and statutory regulations the following order of priority shall govern:

- Statutory regulations
- Data sheets
- Job specification
- This specification
- Codes and standards

3.0 GENERAL REQUIREMENTS

3.1 The offered equipment shall be brand new with state of art technology and proven field track record. No prototype equipment shall be offered.

3.2 Vendor shall ensure availability of spare parts and maintenance support services for the offered equipment for at least 15 years from the date of supply

3.3 Vendor shall give a notice of at least one year to the end user of equipment before phasing out the product/spares to enable the end user for placement of order for spares and services.

3.4 Vendor shall ensure proper co-ordination with the driven equipment supplier in selection/sizing of offered variable frequency drive system.

4.0 SITE CONDITIONS

4.1 The drive system shall be designed to operate under specified site conditions as specified in the data sheets. If not specifically mentioned therein, a design ambient temperature of 50°C and an altitude not exceeding 1000 metres above mean sea level shall be considered.

4.2 The AC drive shall be installed indoors in a non-hazardous, air-conditioned or pressurized room, as specified in data sheet. Transformer installation (outdoor/ indoor) shall be as indicated in datasheet. Motor shall be installed outdoors in safe or hazardous area as specified in datasheet.

4.3 All the equipment shall be designed for continuous duty as per nameplate rating under the specified ambient conditions.

5.0 DESIGN AND FABRICATION REQUIREMENTS

5.1 Performance Requirement

5.1.1 The system shall be energy efficient, designed as standard product and shall provide very high reliability, high power factor, low harmonic distortion and low vibration/ wear / noise. It shall be easy to install in minimum time and expense and no special tools shall be required for routine maintenance.


5.1.2 The system shall be designed to deliver the motor input current and torque for the complete speed torque characteristics of the driven equipment, with input supply variation of $\pm 10\%$ and frequency variation of $\pm 3\%$. The system shall be suitable for the load characteristics and the operational duty of the driven equipment. It shall be capable of withstanding the thermal and dynamic stresses and the transient mechanical torque, resulting from short-circuit.

5.1.3 The drive system shall be designed to operate in one or more of the following operating modes as to suit characteristics of the driven equipment or specified in the data sheet:

- a. Variable torque changing as a function of speed i.e. Speed squared
- b. Constant torque over a specific speed range

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- c. Constant power over a specific speed range where the torque decreases when speed increases
- d. Any other as specified in data sheet
- 5.1.4 The drive controller shall be equipped with microprocessor based digital regulator with programmable functions. The power control regulator logic shall provide for an acceleration/deceleration current limit curve and shall be capable of field adjustments without shutting the system down. Linear acceleration and deceleration shall be separately programmable from 0.1 to 20 seconds.
- 5.1.5 The System shall be suitable for single quadrant operation and the speed variation shall be with range 10-100 % unless otherwise specified in data sheet with speed set accuracy of $\pm 1\%$ of rated maximum speed and steady state regulation of $\pm 0.5\%$ of rated speed.
- 5.1.6 The total harmonic distortion (THD) of the voltage and current at inverter output shall be as per IEC 61800 and same shall be considered in the design of the motor. The dv/dt limits & Vpeak shall also be as per IEC-61800-2.
- 5.1.7 Harmonics at the supply side of the drive system at primary of the main input transformer shall be restricted within the maximum allowable levels of current and voltage distortion as per recommendations in the latest edition of IEEE-519. The vendor shall perform design calculation for harmonic filter system considering VFD connected to the power system and including the supply of harmonic filters along with all accessories which shall be installed at owner's power system unless otherwise specified. These harmonic studies shall be conducted with maximum and minimum system fault level, cable capacitance, system equipment reactance etc. The studies shall highlight but not be limited to maximum load current, expected resonant frequencies, need of harmonic filters, sequence of switching of filters, voltage wave form, rating of equipments/ feeder for feeding filters from owner's switchgear etc.
- 5.1.8 Unless otherwise specified, the overload capacity of the controller shall be 150% of rated current of motor for one minute for constant torque applications, and 110% of rated current for one minute for variable torque applications at rated voltage. If the motor load exceeds the limit, the drive shall automatically reduce the frequency and voltage to the motor to guard against overload. If load demands exceed the current limit for more than 1 minute, the drive shall shutdown to prevent over heating of the motor and damage to the drive.
- 5.1.9 During operation, the system shall be capable of developing sufficient torque under all load conditions to respond to a 20% alteration in speed set point within a time limit upto 60 seconds.
- 5.1.10 The integrator action of the speed set point alteration shall be independently adjustable for both an upward and a downward alteration. The minimum time interval between set point adjustments by the distributed control system shall be considered as 10 seconds.
- 5.1.11 The drive shall trip in case the speed exceeds 105% of the maximum operational speed or reduces to 95% of the minimum operational speed for more than 10 seconds.
- 5.1.12 Maximum noise level from the drive at 1-meter distance, under rated load with all normal cooling fans operating shall not exceed 85 dBA.
- 5.1.13 Variable frequency drive shall be arranged so that it can be operated in an open circuit mode, disconnected from the motor for start up adjustments and troubleshooting/ maintenance.
- 5.1.14 Voltage at motor neutral shall be maintained at ground potential for the total operating condition.
- 5.2 Control Requirement**
 - 5.2.1 The system shall operate on constant V/f supply with required voltage boost capability in low frequency mode of operation.

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- 5.2.2 Short time voltage dips up to 20% of nominal voltage (e.g. in case of a large motor start up connected to the same bus as VFD) shall not cause the control system to stop functioning and shall not trip the drive system.
- 5.2.3 The system shall also be equipped with a momentary powerloss ride through feature which will restart the system in case of voltage dip over 20% or power interruptions for less than 2 seconds, with recovery of the voltage to its nominal value .. The drive shall have the facility to block this feature, if required by the operator. Upon restart, the converter shall be capable of synchronizing onto a rotating motor and develop full acceleration torque within 10 seconds.
- 5.2.4 The system shall be suitable for number of starts as per attached specification for High Voltage Motors.
- 5.2.5 The power controller shall be controlled to always start the motor in the forward direction. Logic shall be provided to prevent the motor from being started in the reverse direction.
- 5.2.6 The drive motor shall be speed controlled corresponding to 4-20mA or 0-10 V reference input signal. Unless otherwise specified, upon complete loss of the user's speed reference signal, the drive shall automatically run at constant speed as at 80-100% of the last speed reference available prior to the loss of signal.
- 5.2.7 It shall be possible to vary the speed of the drive in either manual or auto mode. Auto/Manual selection shall be from VFD panel unless otherwise specified.
- a. With the selector switch in "manual" mode, the operator shall be able to set the speed through key pad (mounted on front of the drive panel) or from speed increase/decrease push buttons (from the field). Motor operated potentiometer shall be provided as a speed set point device.
 - b. With the selector switch in "auto" mode, speed of the motor shall be controlled from a 4-20 mA signal, from owner's PLC/DCS (Process Control) system. Necessary equipment required for interfacing with PLC/DCS shall also be provided in the VFD panel.
 - c. Local/Remote selector switch shall be provided in local control station (in Field). With the selector switch in "Local" mode, the operator shall be able to start and set the speed through local control station (in Field). With the selector switch in "Remote" mode, speed of the motor shall be controlled either from VFD panel or from Owner's PLC/DCS as explained in a) and b) above.
- 5.2.8 The required provision for the interface with remote PLC/DCS located at control room shall be either through hardwired connection (with potential free contacts and transducers as described elsewhere in this specification) or through serial communication link as defined in the datasheet.
- 5.2.9 Drive system shall have provision for interface with upper level automation such as Substation monitoring system or electrical control system in case specified in the data sheet/job specification.
- 5.2.10 The closed loop control feed back for the drive system having out put transformer shall be tapped from the secondary side of the output transformer.

5.3 Panel Construction

- 5.3.1 The panel shall include suitable semi conducting power devices (Diodes/IGBT/IGCT/ IEGT/SGCT) modules with protective devices, reactors (if required) , filters, control circuit, control accessories, indication and annunciation etc. The construction of the panel shall provide effective protection against electromagnetic emissions and shall meet the design requirement of relevant standards.
- 5.3.2 Upstream breaker 'ON/OFF/TRIP' indications and remote breaker closing and trip push buttons shall be provided on the front door.

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- 5.3.3 Safety Interlock shall be provided so that power cabinet can't be opened unless the upstream breaker is disconnected, safety-grounding switch is closed and DC link capacitor is discharged. Power source breaker can only be closed once the earthing switch is open and panel door is closed with lock defeat facility.
- 5.3.4 The drive shall be suitably housed in sheet steel panels and shall be fabricated using cold rolled sheet steel. The sheet steel used for the panel shall be of minimum 2 mm CRCA. The panel shall be suitable for indoor installation, if not otherwise specified. The panel shall be free standing with degree of enclosure protection as IP-31. Maximum and minimum operating height shall be 1900 mm and 300 mm respectively.
- 5.3.5 Bolted un-drilled gland plate shall be provided at bottom. Clamp type terminals shall be used for connection of all wires up to 10 mm², and terminal for higher sizes shall be bolted type suitable for cable lugs. Minimum space for power cable termination shall be 600mm clear from bottom of the cable gland plate.
- 5.3.6 Bus bars shall be of electrolytic copper/aluminium, sleeved, color coded separately for AC and DC system. All the live parts shall be sleeved / shrouded to ensure complete safety to personnel intending to carry out routine inspection by opening the panel doors. All the equipment inside the panel and on the doors shall be provided with suitable nameplate.
- 5.3.7 All the switches, component and accessories which are essential for normal and emergency operation shall preferably be mounted on the door and shall be operable externally. All the analogue instruments, where provided, shall be switchboard type, back connected & of size 96x96mm. Scale shall have red mark indicating maximum permissible operating rating.
- 5.3.8 Each panel shall be provided with illuminating lamp/11 W CFL with switch and fuse. 5/15A, 240V power socket with switch and fuse shall be provided. Each panel shall have space heater with switch fuse and variable setting thermostat.
- 5.3.9 Copper earth bus of min. 30x6 sq.mm. upto short circuit withstand capacity of 31.5kA and 50x6 sq.mm. for a short circuit withstand capacity above 31.5kA shall be provided in the panel with provision for connection to owner's plant earth grid. All the non-metallic components/parts shall be connected to the main earth bus bar. Separate earth bus bar and stud for electronic control system if required shall be provided.
- 5.3.10 All panels shall be of same height so as to form a uniform line-up, to give good aesthetic appearance.
- 5.3.11 All the control wiring shall be enclosed in plastic/ metal channel. Each wire shall be identified at both ends by self-sticking wire marker tapes or PVC ferrules. Power and control wiring inside the panel shall be done with BIS approved, PVC insulated, fire retardant, low smoke, copper conductor wire 1.5mm² size wire shall normally be used provided the control fuse rating is 10 Amps or less and 2.5 mm² size for control fuse rating above 16 A for electrical circuits and 0.5mm² for electronic circuits. All wires shall be ferruled and terminals shall be properly numbered, minimum 20% spare terminals shall be provided.
- 5.3.12 All electronic modules and components shall be accessible from front of panel only. Modular assemblies for both the system control electronic equipments and power electronic equipments shall be used.
- 5.3.13 Low voltage compartment and cabling shall be electrically and physically separated from the high voltage compartment.
- 5.3.14 DC link capacitor and pre-charging & discharging circuit shall be preferably mounted in the rear of the panel.
- 5.3.15 Suitable eyebolts/ lifting clamps/ strap & cradle arrangement shall be provided for lifting of the panel/shipping section. The bolts, when removed shall not leave any opening in the panel.
- 5.3.16 Acrylic type transparent insulating material shall be used for covering live components.

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5.3.17 Drive keypad, operator control panel required for control, monitoring and measurements shall be supplied and installed outside the panel on the front door. It shall be accessible for operation without opening the front door and shall be non-removable type.

5.3.18 All equipment shall be complete with cable glands, lugs etc. and cable glands shall be single or double compression type for indoor and outdoor equipment respectively. Cable glands shall also be suitable for the hazardous area application if specified in data sheet.

5.4 Cooling

5.4.1 The drive panel shall be naturally cooled or water cooled type as per manufacturer's standards. However, it is preferred to have natural air cooled system. If unavoidable, forced type-cooling system shall be provided. Cooling system shall include well-dimensioned panel, adequate cooling airflow path, modular cooling fan and if necessary, panel cooling fan or water-cooling system shall be considered. Vendor shall ensure that the panel dimensions and flow paths have been designed for continuous running at the specified ambient without overheating. For fan cooled drives, redundant ventilating fans (N+ 1) shall be provided. In case redundant cooling fan is not possible to be mounted in the panel, same shall be supplied loose.

5.4.2 For water-cooled drives, entire cooling system including but not limited to heat exchanger, flow and pressure meters and pumps shall be in vendor's scope. The system shall be provided with closed circuit water cooling system, requiring only make up water required for topping up. The cooling water pumps, in case provided, shall have 100% redundancy. Water quality/characteristics shall be as defined in the data sheet and selected cooling water system components/material shall be suitable for the same. Adequate safety measures shall be incorporated in water cooled drives such that no leakage is there which results in malfunctioning of electronic devices. Proper segregation between water cooling system and other equipment shall be provided. It is preferred that cooling cabinet panel shall be separated from the main panels.

5.4.3 Necessary starters shall be provided within the VFD panels for the Ventilation fans, Cooling Water circulation pumps, any other auxiliary motor etc. The system provided shall be interfaced with drive starting and shutdown so that safety interlocks such as start permit from cooling system to drive and trip signal from cooling system to drive in case of cooling system failure etc., are incorporated in the overall sequence logic.


5.4.4 MCB for motor space heater, auxiliary power supply if required for local panel, drive panel space heater etc. shall be included and mounted in easy accessible location.

5.5 Equipment/ Component Specification

5.5.1 Motor

The motor shall be designed, constructed and tested in accordance with the latest revision of Specification /data sheet for High Voltage Induction / Synchronous Motor, in addition to the following requirements:

- a. The motor shall be suitable for operation with a solid-state power supply consisting of an adjustable frequency inverter for speed control.
- b. The motor shall be suitable for the current waveforms produced by the power supply including the harmonics generated by the drive.
- c. The motor shall be designed to operate continuously at any speed over the range (10-100%) of rated speed unless otherwise specified in data sheet.
- d. The permitted voltage variation should take into account the steady state voltage drop across the AC drive and all other system components upstream of the motor.

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- e. Motors required to be transferred to DOL by-pass mode shall be rated for specified variations in system line voltage and frequency. Starting current of motor in DOL bypass mode shall be limited to value specified in motor specifications, unless otherwise specified in datasheets.
- f. The motor shall be constructed to withstand torque pulsations resulting from harmonics generated by the solid-state power supply.
- g. The motor insulation shall be designed to accept the applied voltage waveform, within the V_{peak} and dv/dt limits as per IEC-61800-4 and necessary co-ordination between the VPD manufacturer & motor manufacturer W.r.t. incorporation of VPD output parameter in the design of motor shall be carried out.
- h. The drive manufacturer shall be solely responsible for proper selection of the motor for the given load application and the output characteristics of the drive.
- i. Motors shall be provided with Resistance Temperature Detectors (RTDs).

5.5.2 Converter Transformer/ Output transformer

- a. The converter transformer shall be dry type or oil filled type as specified in the data sheet. In case of the dry type transformer, it shall be mounted in the drive system panel unless specified otherwise in the datasheet. Offered transformer shall be as per enclosed Specifications/data sheet.
- b. The impedances of converter input transformers with more than one secondary windings for 12/18/24/36 pulse systems shall be selected to ensure equal load/current sharing between the secondary windings, the converters and the motor windings under all operational conditions including starting and restarting.
- c. Drive output transformer considered only for the purpose of meeting standard rated motor voltage i.e. 3300, 6600V, 11000V shall not be provided unless otherwise agreed between purchaser and the manufacturer.

5.5.3 Power Converter

- a. The static power converter shall consist of a line side power converter for operation as a rectifier and a load side power converter for operation as a fully controlled inverter. Power converter shall be fast switching, most efficient and low loss type.
- b. Adequate short circuit and over voltage protection shall be provided for the converter and inverter system.
- c. All power converter devices shall include protective devices, snubber networks and dv/dt networks as required.
- d. The current rating of the converter's semi-conductor components shall not be less than 120% of the nominal current flowing through the elements at full load of the VFD through the entire speed range.
- e. All power diodes shall be of silicon type with minimum V_{BO} rating as 2.5 times the rated operating voltage.
- f. The power converter circuit shall be designed so that motor can be powered at its full nameplate rating continuously without exceeding its rated temperature rise due to harmonic currents generated by the inverter operation.
- g. The conversion devices and associated heat sinks shall be assembled such that individual devices can be replaced without requiring the use of any special precautions/tools.
- h. The cooling system of the electronic components, if provided, shall be monitored and necessary alarms shall be provided to prevent any consequential damage to the power control devices.

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- i. Offered system shall also take into account the distance between Drive panel and motor and system shall include all material and accessories to make system suitable for a distance of 350m unless otherwise specified in the data sheet.

5.5.4 DC Link Reactor

- a. Smoothing reactors for the DC link shall be designed to sufficiently decouple the rectifier and inverter portion of the converter and to limit fault currents in this circuit.
- b. Unless otherwise specified, the reactor shall be air-cooled or fan cooled type located within the panel.
- c. Reactor shall be suitable for operation with the non-sinusoidal current wave shapes and DC components under all operational conditions of the system without exceeding its temperature limits.

5.5.5 Output Filter

VFD output current waveform should be inherently sinusoidal at all speeds, with harmonic limits as specified in this specification. Output filter shall be provided, if required. Output filter capacitors shall be provided with discharge circuits to ensure that all residual stored charge is reduced to less than 50 V DC within 300 seconds after a loss of AC voltage. All capacitor shall be maintenance-free and self-healing type.

The VFD system shall inherently protect motor from high voltage dv/dt stress, independent of cable length to motor. Output filter shall be an integral part of the VFD system and included within the VFD enclosure.

5.5.6 Bypass Feature

- a. Bypass feature along with motor protection relay and output side isolator/breaker shall be provided by purchaser unless otherwise specified in the datasheet. All necessary interlocks as required for safe and reliable operation of VFD system along with bypass feeder and output side isolator/breaker provided by Purchaser shall be provided in VFD system.
- b. Bypass starter shall be in separate compartment and switching scheme shall be such that in case of drive mal-operation, the motor could be taken on bypass control manually, while the drive could be attended independently. Suitable interlock shall be provided such that bypass mode and VFD mode shall not operate simultaneously.

5.5.7 Local Motor Control Station

- a. The local motor control station, to be installed in the field near the motor shall conform to the attached specifications. Components and accessories that are required in the local motor control station may be mounted on the local field mounted panel envisaged for the driven equipment.
- b. Meters in the local control station shall be suitable for 4-20mA transducer outputs and shall be calibrated for the actual motor current. Further, for drives with bypass facility, the meters shall be capable of reading bypass mode full load and starting currents as well as the VFD mode drive current.

5.6 Protection, Control, Metering, Indication and Annunciation

- 5.6.1 The system vendor shall provide all the necessary system control, protection, alarm and metering equipment for the entire drive system and its auxiliary equipment.
- 5.6.2 Automatic sequence control shall include start-up of cooling system, auxiliary system of the motor, interlock checking, automatic start and run-up of drive, planned and emergency shutdown. The same shall be processed through microprocessor-based system.

5.6.3 Operator Control Panel

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- a. Each drive shall be equipped with a front mounted operator control console consisting of a backlit alphanumeric display and a keypad with keys for parameterization and adjusting parameter which shall not be limited to Start/Stop, Local/Remote, Auto/Manual, Increase/Decrease, menu navigation and protection and measurement parameter selection, etc.
- b. All parameter names, fault messages, warnings and other information shall be displayed in complete English words or standard English abbreviations to allow the user to understand the display without the use of a manual or cross-reference table. This shall also be used for the modification of all electrical values, configuration parameters, drive menu parameters, application and activity function access, faults, local control, adjustment storage, self test and diagnostics. Keypad shall be operable with password for changing the protection setting, safety interlock etc. However, the parameters such as measurements, setting, mode of drive etc. shall be allowed to be viewed without any password.
- c. Operator console shall have facility/ port to connect external hardware such as Laptop etc. Console shall have facility to upload and download all parameter settings from one drive to another identical drive for start-up and operation.
- d. Drive system control shall also have facility to receive tripping signal from upstream breaker for tripping and also provision for closing upstream breaker after all required process parameters are achieved.
- e. User-friendly software for operation and fault diagnostic shall be loaded in the drive system panel before commissioning.

5.6.4 Protective Features

The system shall incorporate adequate protective features, properly coordinated for the drive control and for the motor but not limited to the following:

- I. Incoming line surge protection
- II. Under / Over voltage protection
- III. Phase loss protection.
- IV. Programmable over current protection and under load protection.
- V. Inverter Fault.
- VI. Over frequency/Over speed of motor
- VII. Ventilation loss (In case same is not provided, drive shall generate an over temperature fault alarm and suitable sensors, as required for same, shall be provided).
- VIII. Over temperature of equipment.
- IX. Specific motor protection, including motor winding, bearing temperatures, over current, overload, negative phase sequence and earth fault protections etc.
- X. System earth fault protection.
- XI. Excitation system protection for synchronous motor
- XII. Over and under frequency, rotor earth fault (if applicable), field failure protection for synchronous motor
- XIII. Additional protection, if any for the drive system

5.6.5 Control

The following controls shall be provided as a part of the Operator Control Panel or through separate switches.

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- I. Start/Stop
- II. Speed control (Raise/Lower)
- III. Forward/Reverse (if specified)
- IV. Auto/Manual /Test mode
- V. Local/Remote
- VI. Emergency stop
- VII. Start/Stop for bypass starter (where specified)
- VIII. Trip-Remote Breaker
- IX. Excitation control system for synchronous motors
- X. Sequential switching of filters

5.6.6 Indications

Vendor shall provide indications as required for normal operation and for ease of maintenance, which shall not be limited to the following indications.

- I. Motor running
- II. Motor stopped
- III. VFD System Fault
- IV. System ready to start
- V. AC mains ON
- VI. Motor over speed
- VII. Rectifier output 'ON'
- VIII. Motor zero speed
- IX. Remote breaker trip
- X. Excitation system healthy for synchronous motors

Above indications may be provided as a part of the operator control panel, i.e. door mounted keypad or through hardwired LEDs. LEDs provided for indication shall be cluster type with adequate brightness and minimum 2 Nos LEDs chips per light. LEDs shall be connected in parallel and each LED chip having diameter not less than 3mm.

Potential free contacts for items i to iv shall be wired separately for remote indications in DCS system.

5.6.7 Metering

Digital display of the following parameters shall be as a part of the Operator Control Panel, selectable by the operator.

- I. Output voltage
- II. Output current-VFD model Bypass mode
- III. Output frequency
- IV. Drive thermal state

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- V. Motor speed
- VI. Motor energy meter
- VII. Hour Run
- VIII. Voltage and current meter for excitation system of synchronous motor
- IX. KVAR, power factor meter for synchronous motors
- X. Necessary transducer shall be provided with 4-20mA output for indicating motor
- XI. speed and motor current in DCS unless otherwise specified for other parameters.

5.7 **Fault Diagnostic**

Fault diagnostic shall be built into the system to supervise the operation and failure of the system. The information regarding failure of any of the system including, shutdown of the system, shall be available for a period of minimum 4 days (96 hours) after a shutdown, even though no supply would be available to the system. The system may be totally de-energized for maintenance or otherwise. It shall be possible to retrieve the record of events prior to tripping of the system or de-energisation. Auxiliary supply to the system components or to the electronics (firmware) for the diagnostics / display shall be taken care by the manufacturer for this purpose.

5.8 **External Power supply for auxiliary and Control Circuit**

Auxiliary power supply for devices external to VFD module, space heater supply for Motor, VFD panel space heater, auxiliary power supply for transformers, cubicle 11W CFL lamps, indicating lamps, digital meters (Ammeter, Speedometer) etc. shall operate on 240 volts single phase AC supply provided by purchaser.

All control circuit shall operate at maximum voltage of 240V AC or 220V DC unless otherwise specified in the datasheet.

Vendor shall include supply of all control transformers, protective devices, associated accessories etc. and any other control supply voltage required for the system shall be derived by the vendor from the power supply made available by purchaser.

5.9 **Reliability Features**

The expected lifetime of the drive system shall be min. 20 years. The system including all individual components forming part of the system shall have an availability of minimum 0.997 and a minimum MTBF of 4 years.

5.10 **Maintenance features**

The controller design shall incorporate the following maintenance features:

- Modular construction

- All components shall be easily accessible.

- Standard diagnostics to aid maintenance personnel. These shall include LED or alphanumeric displays, test or measurement points.

5.11 **Painting**

5.11.1 After preparation of the under surface, the panel shall be spray painted with two coats of epoxy based final paint or shall be powder coated. The colour shade of final paint shall be as RAL 7032, unless specified otherwise. Panel finish shall be free from imperfections like pinholes, orange peels, runoff paint, etc.

5.11.2 All unpainted steel parts shall be zinc passivated, cadmium plated or suitably treated to prevent rust and corrosion. If these parts are moving elements, then these shall be greased.

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6.0 INSPECTION, TESTING AND ACCEPTANCE

- 6.1 During fabrication, the drive shall be subject to inspection by PDIL / Owner, or by an agency authorized by the Owner, to assess the progress of work, as well as to ascertain that only quality raw material is used.
- 6.2 All tests shall be carried out at the manufacturer's works under his care and expense. The tests shall be witnessed by an inspector of PDIL/Owner or of an agency authorized by the owner. Prior notice of minimum 4 weeks shall be given to the inspector for witnessing the tests.
- 6.3 All Routine & Type Tests shall be conducted as per the NIT for HV variable frequency drive as per IEC 61800-4. Moreover, combined test for VFD and motor at vendor's works shall be carried out.
- 6.4 String Test with driven equipment
- If a string test with driven equipment is specified in the data sheet of the driven equipment, it shall be carried out with the job equipment.

7.0 SPARES

- 7.1 Commissioning Spares: Commissioning spares, as required, shall be supplied with the main equipment. Item-wise list of recommended commissioning spares shall be furnished for approval.
- 7.2 Spare Spares for 2 Years operation (Mandatory), as specified shall be supplied.
- 7.3 Recommend 2 years Operational Spares (other than mandatory spare) alongwith recommended quantity & item-wise unit price shall be furnished.
- 7.4 All spare parts shall be identical to the parts used in the equipment

8.0 DRAWINGS

- 8.1 Vendor shall submit to Purchaser, for approval, before completion of manufacturing and assembly of equipment following drawings and literature.
- (i) Installation and maintenance manual including trouble-shooting chart.
 - (ii) Panel drawings and cable schedule
 - (iii) Block diagram and control logic.


9.0 CERTIFICATION

The motors and associated Variable frequency drive system equipment shall have test certificates issued by recognized independent test house (CIMFRI BASEEFA/ LCIE/UL/FM or equivalent). All indigenous motors shall conform to Indian Standards and shall be certified by Indian testing agencies. All motors (indigenous and imported) shall also have valid statutory approvals as applicable for the specified hazardous location. All indigenous flameproof motors shall have valid BIS license and marking as required by statutory authorities.

Also the motor nameplate shall clearly indicate that the motor is suitable for operation with variable frequency drive along with VFD make and model number.

10.0 PACKING AND DESPATCH

All the equipment shall be divided in to several shipping sections for protection and ease of handling during transportation. The equipment shall be properly packed for selected mode of transportation i.e. ship/rail or trailer. The equipment shall be wrapped in polyethylene sheets before being placed in wooden crates/cases to prevent damage to the finish. Crates/cases shall have skid bottoms for handling. Special notations such as 'Fragile', 'This side up', 'Weight', 'Owner's particulars', 'PO nos.' etc., shall be clearly marked on the package together with other details as per purchaser for scrutiny. The equipment may be stored outdoors for

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long periods before installation. The packing shall be completely suitable for outdoor storage, in areas with heavy rains/high ambient temperature.

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TECHNICAL SPECIFICATION

MEDIUM VOLTAGE VARIABLE FREQUENCY DRIVE SYSTEM

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1.0 SCOPE

- 1.1 The scope of this specification is to define the minimum technical requirements for the design, manufacture, testing and supply of Medium Voltage, AC Variable Frequency Drive system. The VFD system shall be complete with Squirrel Cage Induction Motor/ Synchronous Motor as specified in data sheet, Converter, Converter input transformer, drive output transformer, DC link reactor with associated auxiliaries, harmonic filters and field mounted local motor control panel.
- 1.2 The Vendor shall be responsible for engineering and functioning of the complete system, meeting the intent and requirement of this specification and data sheets. This shall include but not be limited to inverter sizing, transformer sizing, transformer impedance selection, vector group, input and output harmonic filter design and sizing, output dv/dt filter sizing, motor cable selection and motor sizing/selection.
- 1.3 This specification applies to drives connected to line voltage up to 1000 V, AC.

2.0 CODES AND STANDARDS

- 2.1 The equipment shall comply with the requirements of latest revision of the following standards issued by BIS, unless otherwise specified:
- | | |
|----------------|--|
| IS:325 | Three-phase Induction Motors |
| IS:3700 | Essential Ratings and Characteristics of Semiconductor Devices |
| IS:3715 | Letter symbols for semi-conducting devices |
| IS:4411 | Code of designation of semi-conducting devices |
| IS:5001 | Guide for preparation of drawings of semiconductor devices and Integrated Circuits |
| IS:5469 | Code of practice for the use of semiconductor Junction Devices |
| IS:14901 | Semi-conductor devices- Discrete devices & Integrated Circuits |
| IS:15880 | Three Phase Cage Induction motors when fed from IGBT Converters Application Guide |
| IS:8789 | Values of Performance characteristics for Three Phase induction motor |
| IS: 12615 | Energy Efficient Induction Motors - Three Phase Squirrel Cage |
| IS/IEC:60947 | Low Voltage Switchgear and Control gear |
| IEC:60 146-1-3 | Semiconductor Convertors general requirements and line commutated convertors- Transformer & reactors |
| IEC:61800 | Adjustable speed electrical power drive systems |
| IEEE:519 | Recommended Practices and requirements for Harmonics Control in Electrical power system |
- 2.2 In case of imported equipment, standards of the country of origin shall be applicable, if these standards are equivalent or stringent than the applicable Indian standards.
- 2.3 The equipment shall also conform to the provisions of Indian Electricity rules and other statutory regulations currently in force in the country.
- 2.4 In case Indian standards are not available for any equipment, standards issued by IEC/BSNDE/IEEE/NEMA or equivalent agency shall be applicable.
- 2.5 In case of any contradiction between various referred standards/specifications/data sheet and statutory regulations the following order of priority shall govern:

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- Statutory regulations
- Data sheets
- Job specification
- This specification
- Codes and standards

3.0 GENERAL REQUIREMENTS

- 3.1 The offered equipment shall be brand new with state of art technology and proven field track record. No prototype equipment shall be offered.
- 3.2 Vendor shall ensure availability of spare parts and maintenance support services for the offered equipment for at least 15 years from the date of supply
- 3.3 Vendor shall give a notice of at least one year to the end user of equipment before phasing out the product/spares to enable the end user for placement of order for spares and services.
- 3.4 The vendor shall be responsible for design, engineering and manufacturing of the complete VFD system to fully meet the intent and requirements of this specification and attached data sheets.

4.0 SITE CONDITIONS

- 4.1 The AC drive system shall be designed to operate under specified site conditions as specified in the data sheets. If not specifically mentioned therein, a design ambient temperature of 50°C and an altitude not exceeding 1000 metres above mean sea level shall be considered.
- 4.2 The AC drive shall be installed indoors in a non-hazardous, air-conditioned or pressurized room, as specified in data sheet.
- 4.3 All the equipment shall be designed for continuous duty as per nameplate rating under the specified ambient conditions.

5.0 DESIGN AND FABRICATION REQUIREMENTS

5.1 Performance Requirement

- 5.1.1 The system shall be energy efficient, designed as standard product and shall provide very high reliability, high power factor, low harmonic distortion and low vibration/ wear/noise. It shall be easy to install in minimum time and expense and no special tools shall be required for routine maintenance.
- 5.1.2 The system shall be designed to deliver the motor input current and torque for the complete speed torque characteristics of the driven equipment, with input supply variation of $\pm 10\%$ and frequency variation of $\pm 3\%$. The system shall be suitable for the load characteristics and the operational duty of the driven equipment. It shall be capable of withstanding the thermal and dynamic stresses and the transient mechanical torque, resulting from short-circuit.
- 5.1.3 The drive system shall be designed to operate in one or more of the following operating modes as to suit characteristics of the driven equipment or specified in the data sheet:
- a. Variable torque changing as a function of speed i.e. Speed squared
 - b. Constant torque over a specific speed range
 - c. Constant power over a specific speed range where the torque decreases when speed increases
 - d. Any other as specified in data sheet
- 5.1.4 The drive controller shall be equipped with microprocessor based digital regulator with programmable functions. The power control regulator logic shall provide for an acceleration/deceleration current limit curve and shall be capable of field adjustments without

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shutting the system down. Linear acceleration and deceleration shall be separately programmable from 0.1 to 20 seconds.

- 5.1.5 The System shall be suitable for single quadrant operation and the speed variation shall be with range 1:100 unless otherwise specified in data sheet with speed set accuracy of $\pm 1\%$ of rated maximum speed and steady state regulation of $\pm 0.5\%$ of rated speed.
- 5.1.6 The total harmonic distortion (THD) of the voltage and current at inverter output shall be as per IEC 61800 and same shall be considered in the design of the motor. The dv/dt limits & Vpeak shall also be as per IEC-61800-2.
- 5.1.7 Harmonics at the supply side of the drive system at primary of the main input transformer shall be restricted within the maximum allowable levels of current and voltage distortion as per recommendations in the latest edition of IEEE-519. The vendor shall perform design calculation for harmonic filter system considering VFD connected to the power system and including the supply of harmonic filters along with all accessories which shall be installed at owner's power system unless otherwise specified. These harmonic studies shall be conducted with maximum and minimum system fault level, cable capacitance, system equipment reactance etc.
- 5.1.8 The controller output overload capacity shall be 150% of rated current of motor for one minute for constant torque applications, and 110% of rated current for one minute for variable torque applications at rated voltage. If the motor load exceeds the limit, the drive shall automatically reduce the frequency and voltage to the motor to guard against overload. If load demand exceeds the current limit for more than 1 minute, the drive shall shut down to prevent over heating of the motor and damage to the drive.
- 5.1.9 During operation, the system shall be capable of developing sufficient torque under all load conditions to respond to a 20% alteration in speed set point within a time limit upto 60 seconds.
- 5.1.10 The integrator action of the speed set point alteration shall be independently adjustable for both an upward and a downward alteration. The minimum time interval between set point adjustments by the distributed control system shall be considered as 10 seconds.
- 5.1.11 The drive shall trip in case the speed exceeds 105% of the maximum operational speed or reduces to 95% of the minimum operational speed for more than 10 seconds.
- 5.1.12 Maximum noise level from the drive at 1-meter distance, under rated load with all normal cooling fans operating shall not exceed 85 dBA.
- 5.1.13 Variable frequency drive shall be arranged so that it can be operated in an open circuit mode, disconnected from the motor for start up adjustments and troubleshooting/ maintenance.

5.2 Control Requirement

- 5.2.1 The system shall operate on constant V/f supply with required voltage boost capability in low frequency mode of operation.
- 5.2.2 Short time voltage dips up to 20% of nominal voltage (e.g. in case of a large motor start up connected to the same bus as VFD) shall not cause the control system to stop functioning and shall not trip the drive system.
- 5.2.3 The system shall also be equipped with a momentary powerloss ride through feature which will restart the system in case of voltage dip over 20% or power interruptions for less than 2 seconds, with recovery of the voltage to its nominal value .. The drive shall have the facility to block this feature, if required by the operator. Upon restart, the converter shall be capable of synchronizing onto a rotating motor and develop full acceleration torque within 10 seconds.
- 5.2.4 The system shall be suitable for number of starts as per attached specification for Medium Voltage Motors.

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- 5.2.5 The power controller shall be regulated to always start the motor in the forward direction. Logic shall be provided to prevent the motor from being started in the reverse direction.
- 5.2.6 The drive motor shall be speed controlled corresponding to 4-20mA or 0-10 V reference input signal. Upon complete loss of the user's speed reference signal, the drive shall automatically run at constant speed as at 80-100% of the last speed reference available prior to the loss of signal.
- 5.2.7 It shall be possible to vary the speed of the drive in either manual or auto mode. Auto/Manual selection shall be from VFD panel unless otherwise specified.
- With the selector switch in "manual" mode, the operator shall be able to set the speed through key pad (mounted on front of the drive panel) or from speed increase/decrease push buttons (from the field). Motor operated potentiometer shall be provided as a speed set point device.
 - With the selector switch in "auto" mode, speed of the motor shall be controlled from a 4-20 mA signal, from owner's PLC/DCS (Process Control) system. Necessary equipment required for interfacing with PLC/DCS shall also be provided in the VFD panel.
 - Local/Remote selector switch shall be provided in local control station (in Field). With the selector switch in "Local" mode, the operator shall be able to start and set the speed through local control station (in Field). With the selector switch in "Remote" mode, speed of the motor shall be controlled either from VFD panel or from Owner's PLC/DCS as explained in a) and b) above.
- 5.2.8 The required provision for the interface with PLC/DCS (located at remote control room) including the details of communication module and data transfer facility, I/O details shall be furnished. The communication interface shall be via serial communication link with industry standard open protocol i.e. MODBUS/IEC-61850/ RS-485 etc. and same shall be coordinated with the interfacing equipment. In case the vendor is using their proprietary software, the interface software for use with owner's system (software) shall be provided.
- 5.2.9 Drive system shall have provision for interface with upper level automation such as Substation monitoring system or electrical control system in case specified in the data sheet/job specification.
- 5.2.10 The closed loop control feed back for the drive system having output transformer shall be tapped from the secondary side of the output transformer.

5.3 Panel Construction

- 5.3.1 The panel shall include suitable isolating device (i.e. Circuit breaker/MCCB/ Switch fuse) for main supply, contactors, semi conducting power devices (Diodes / IGBT) modules with protective devices, reactors, filters, output isolating device, control circuit, control accessories, indication and annunciation etc.
- 5.3.2 Main isolating device shall function as a manual disconnect and shall be an AC thermal magnetic circuit breaker or a fused switch with dual element fuse to trip automatically on fault currents, as specified in data sheet. Devices shall be lockable in the open position and shall have a minimum interrupting capacity as specified in data sheet. Interlock shall be provided between the door, so that door cannot be opened unless the breaker/switch is open.
- 5.3.3 Safety Interlock shall be provided so that power cabinet can't be opened unless the upstream breaker is disconnected, safety-grounding switch is closed and DC link capacitor is discharged. Power source breaker can only be closed once the earthing switch is open and panel door is closed with lock defeat facility.
- 5.3.4 The drive shall be suitably housed in sheet steel panels and shall be fabricated using cold rolled sheet steel. The sheet steel used for the panel shall be of minimum 2 mm CRCA except the doors & covers that may be made of 2mm CRCA. The panel shall be suitable for indoor installation, if not otherwise specified. The panel shall be free standing with degree of

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enclosure protection as IP-31. Maximum and minimum operating height shall be 1900 mm and 300 mm respectively.

- 5.3.5 Bolted un-drilled gland plate shall be provided at bottom. Clamp type terminals shall be used for connection of all wires up to 10 mm² and terminal for higher sizes shall be bolted type suitable for cable lugs. Minimum space for power cable termination shall be 300mm clear.
- 5.3.6 Bus bars shall be of electrolytic copper/aluminium, sleeved, color coded separately for AC and DC system. All the live parts shall be sleeved / shrouded to ensure complete safety to personnel intending to carry out routine inspection by opening the panel doors. All the equipment inside the panel and on the doors shall be provided with suitable nameplate. All wires shall be ferruled and terminals shall be properly numbered, minimum 20% spare terminals shall be provided.
- 5.3.7 All the power and control switches shall preferably be mounted on the door and shall be operable externally. All the analogue instruments, wherever provided, shall be switch board type, back connected, 96x96mm size. Scale shall have red mark indicating maximum permissible operating rating.
- 5.3.8 Each panel shall be provided with illuminating lamp/II W CFL with switch and fuse. 5/15A, 240V power socket with switch and fuse shall be provided. Each panel shall have space heater with switch fuse and variable setting thermostat.
- 5.3.9 Copper earth bus of min. 30X6 mm size shall be provided at the bottom of the panel extending outside the panel on both sides. All the non-metallic components/parts shall be connected to the main earth bus bar. In case a separate earth bus for electronic control system is required, the same shall be indicated in the drawings.
- 5.3.10 All panels shall be of same height so as to form a uniform line-up, to give good aesthetic appearance.
- 5.3.11 All the control wiring shall be enclosed in plastic/ metal channel. Each wire shall be identified at both ends by self-sticking wire marker tapes or PVC ferrules. Power and control wiring inside the panel shall be done with BIS approved, PVC insulated, fire retardant, low smoke, copper conductor wire 1.5mm² size wire shall normally be used provided the control fuse rating is 10 Amps or less and 2.5 mm² size for control fuse rating above 16 A for electrical circuits and 0.5mm² for electronic circuits. All wires shall be ferruled and terminals shall be properly numbered, minimum 20% spare terminals shall be provided.
- 5.3.12 All electronic modules and components shall be accessible from front of panel only. Modular assemblies for both the system control electronic equipments and power electronic equipments shall be used.
- 5.3.13 DC link capacitor and pre-charging & discharging circuit shall be preferably mounted in the rear of the panel.
- 5.3.14 Suitable eyebolts/ lifting clamps/ strap & cradle arrangement shall be provided for lifting of the panel/shipping section. The bolts, when removed shall not leave any opening in the panel.
- 5.3.15 Acrylic type transparent insulating material shall be used for covering live components.
- 5.3.16 All equipment shall be complete with cable glands, lugs etc. and cable glands shall be single or double compression type for indoor and outdoor equipment respectively. Cable glands shall also be suitable for the hazardous area application if specified in data sheet.

5.4 Cooling

- 5.4.1 Cooling system shall include well-dimensioned panel, adequate cooling airflow path, module cooling fan and if necessary, panel cooling fan. Vendor shall ensure that the panel dimensions and flow paths have been designed for continuous running at the specified ambient without overheating. For fan cooled drives, redundant ventilating fans (N+1) shall be

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provided. Necessary starters shall be provided within the VFD panels for these fans. In case redundant cooling fan is not possible to be mounted, same shall be supplied loose.

- 5.4.2 MCB for motor space heater, auxiliary power supply if required for local panel, drive panel space heater etc. shall be included and mounted in easy accessible location.

5.5 Equipment/ Component Specification

5.5.1 Motor

The motor shall be designed, constructed and tested in accordance with the attached standard specification for Medium Voltage Induction Motor, in addition to the following requirements:

- a. The motor shall be suitable for operation with a solid-state power supply consisting of an adjustable frequency inverter for speed control.
- b. The motor shall be suitable for the current waveforms produced by the power supply including the harmonics generated by the drive.
- c. The motor shall be designed to operate continuously at any speed over the range (10-100%) of rated speed unless otherwise specified in data sheet.
- d. Motor shall be provided with thermistor type temperature detector
- e. The motors shall be provided with Class 'F' insulation with temperature rise limited to Class 'B'.
- f. The permitted voltage variation should take into account the steady state voltage drop across the AC drive and all other system components upstream of the motor.
- g. Motors required to be transferred to DOL by-pass mode shall be rated for specified variations in system line voltage and frequency. Starting current of motor in DOL bypass mode shall be limited to value specified in motor specifications, unless otherwise specified in datasheets.
- h. The motor shall be constructed to withstand torque pulsations resulting from harmonics generated by the solid-state power supply.
- i. The motor insulation shall be designed to accept the applied voltage waveform, within the V_{peak} and dv/dt limits as per IEC-61800-2.
- j. The drive manufacturer shall be solely responsible for proper selection of the motor for the given load application and the output characteristics of the drive.
- k. Motors shall be provided with Resistance Temperature Detectors (RTDs).
- l. Induced voltage at the shaft end of the motor at no load shall not exceed 250 mV rms for roller and ball bearings and 400 mV for sleeve bearings. The non driving end bearing shall be insulated from the motor frame to avoid circulating current. The insulated bearing end shield or pedestal shall bear a prominent warning.

5.5.2 Converter Transformer/ Output transformer

The converter transformer shall be suitable for use with the variable frequency drive system. The impedances of transformers with two secondary windings for 12 pulse systems shall be selected to ensure equal load/current sharing between the two secondary windings, the converters and the motor windings under all operational conditions including starting and restarting. The transformer shall be provided with $\pm 5\%$ off circuit taps in steps of $\pm 2.5\%$.

5.5.3 Power Converter

- a. The static power converter shall consist of a line side power converter for operation as a rectifier and a load side power converter for operation as a fully controlled inverter. Power converter shall be fast switching, most efficient and low loss type.

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- a. Normally, for all output short circuits, the inverter shall interrupt the current before any semi-conductor fuse blows. For internal short circuits, semi-conductor fuse protection shall be provided, and for faults upstream of semi-conductor fuses, the converter shall be able to withstand a three-phase short circuit current until interrupted by normal breaker operation. In case of fuseless design, the failure shall be limited to the particular device, without causing any damage to other parts of the power module. There must be clear annunciation of the failure of the device.
- b. All power converter devices shall include protective devices, snubber networks and dv/dt networks as required.
- c. The current rating of the converter's semi-conductor components shall not be less than 120% of the nominal current flowing through the elements at full load of the VFD through the entire speed range.
- d. All power diodes shall be of silicon type with minimum V_{BO} rating as 2.5 times the rated operating voltage.
- e. The power converter circuit shall be designed so that motor can be powered at its full nameplate rating continuously without exceeding its rated temperature rise due to harmonic currents generated by the inverter operation.
- f. The conversion devices and associated heat sinks shall be assembled such that individual devices can be replaced without requiring the use of any special precautions/tools.
- g. The cooling system of the electronic components, if provided, shall be monitored and necessary alarms shall be provided to prevent any consequential damage to the power control devices.
- h. All the power transistors, thyristors and diodes shall be protected with high-speed semiconductor grade fuse. I2t particulars of the power controller devices and the fuses shall be properly co-ordinated for the selection of fuses.

5.5.4 DC Link Reactor

- a. Smoothing reactors for the DC link shall be designed to sufficiently decouple the rectifier and inverter portion of the converter and to limit fault currents in this circuit. AC line reactors, if provided as per standard vendor design, shall be suitable for harmonic suppression and fault current limitation.
- b. The reactor shall be dry type, air cooled or fan cooled type located within the panel. In case of fan cooled type, operation of fans shall be monitored.
- c. Reactor shall be suitable for operation with the non-sinusoidal current wave shapes and DC components under all operational conditions of the system without exceeding its temperature limits.

5.5.5 Output Filter

VFD output current waveform shall be inherently sinusoidal at all speeds, with harmonic limits as per C1.5.1.6. Output filter capacitors shall be provided with discharge circuits to ensure that all residual stored charge is reduced to less than 50 V DC within 60 seconds after a loss of AC voltage. The VFD system shall inherently protect motor from high voltage dv/dt stress, independent of cable length to motor. Output filter shall be an integral part of the VFD system and included within the VFD enclosure.

5.5.6 Bypass Feature

- 5.5.6.1 Output contactor/Load Break Switch shall be provided for isolation between the output of the controller and the motor for VFD systems with Bypass feature.

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5.5.6.2 Bypass feature shall be provided, if specified in the data sheet. Accordingly Bypass feature with Bypass starter shall meet the following requirements, unless otherwise specified in the data sheet:-

Bypass starter shall comprise of switch-fuse, contactor, bimetal relay meeting the requirements of Type-2 coordination as per IS/IEC-60947. CBCT and ELR shall be provided for motors rated above 22kW & upto 55kW unless otherwise specified in the data sheet. Heavy duty starters shall be provided with saturable type current transformer operated overload relay only, which shall be suitable for motor starting time of 15-60 seconds. For motors rated above 55kW, ACB/MCCB and motor protection relay along with necessary metering shall be provided.

Bypass starter shall be in separate compartment and it shall be possible to isolate and maintain the VFD while drive motor runs in Bypass mode. Three contactors/ breakers shall be used for this purpose, one contactor in the bypass and two contactors across the drive, such that in case of drive mal-operation, the motor could be taken on bypass control, while the drive could be attended by opening its contactors. Suitable interlock shall be provided such that bypass mode and VFD mode shall not operate simultaneously.

5.5.7 Local Motor Control Station

- a. The local motor control station, to be installed in the field near the motor shall conform to the attached specifications. Components and accessories that are required in the local motor control station may be mounted on the local field mounted panel envisaged for the driven equipment.
- b. Meters in the local control station for motors rated above 5.5kW shall be suitable for 4-20mA transducer outputs and shall be calibrated for the actual motor current unless specified otherwise. Further, for drives with bypass facility, the meters shall be capable of reading bypass full load and starting currents, as well as the drive current. Local-off-Remote selector switch shall be provided in the LCS for selection of control from Local (i.e. LCS in Field) and Remote (i.e. from VFD panel / DCS / PLC).

5.6 Protection, Control, Metering, Indication and Annunciation

- 5.6.1 The system vendor shall provide all the necessary system control, protection, alarm and metering equipment for the entire drive system and its auxiliary equipment.
- 5.6.2 Automatic sequence control shall include start-up of cooling system, auxiliary system of the motor, interlock checking, automatic start and run-up of drive, planned and emergency shutdown. The same shall be processed through microprocessor-based system.

5.6.3 Operator Control Panel

- a. Each drive shall be equipped with a front mounted operator control console consisting of a backlit alphanumeric display and a keypad with keys for parameterization and adjusting parameter which shall not be limited to Start/Stop, Local/Remote, Auto/Manual, Increase/Decrease, menu navigation and protection and measurement parameter selection, etc.
- b. All parameter names, fault messages, warnings and other information shall be displayed in complete English words or standard English abbreviations to allow the user to understand the display without the use of a manual or cross-reference table. This shall also be used for the modification of all electrical values, configuration parameters, drive menu parameters, application and activity function access, faults, local control, adjustment storage, self test and diagnostics. Keypad shall be operable with password for changing the protection setting, safety interlock etc. However, the parameters such as measurements, setting, mode of drive etc. shall be allowed to be viewed without any password.

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- c. Operator console shall have facility/ port to connect external hardware such as Laptop etc. Console shall have facility to upload and download all parameter settings from one drive to another identical drive for start-up and operation.
- d. Drive system control shall also have facility to receive tripping signal from upstream breaker for tripping and also provision for closing upstream breaker after all required process parameters are achieved.

5.6.4 User-friendly software for operation and fault diagnostic shall be loaded in the drive system panel before commissioning.

5.6.5 Protective Features

The system shall incorporate adequate protective features, properly coordinated for the drive control and for the motor but not limited to the following:

- I. Incoming line surge protection
- II. Under / Over voltage protection
- III. Phase loss protection.
- IV. Programmable over current protection and under load protection.
- V. Inverter Fault.
- VI. Over frequency/Over speed of motor
- VII. Ventilation loss (In case same is not provided, drive shall generate an over temperature fault alarm and suitable sensors, as required for same, shall be provided).
- VIII. Over temperature of equipment.
- IX. Specific motor protection, including motor winding, bearing temperatures, over current, overload, negative phase sequence and earth fault protections etc.
- X. System earth fault protection.
- XI. Excitation system protection for synchronous motor
- XII. Over and under frequency, rotor earth fault (if applicable), field failure protection for synchronous motor
- XIII. Additional protection, if any for the drive system

5.6.6 Alarms

The system shall incorporate protection alarms, required for various fault conditions, for the Drive motor, Supply cables, Converter Transformer, DC Reactor and the Converter. Alarms shall also be included for the failure of various auxiliaries together with identification of the failing unit, loss of cooling system, various protection devices provided for converter transformer etc.

5.6.7 Control

The following controls shall be provided as a part of the Operator Control Panel or through separate switches.

- I. Start/Stop
- II. Speed control (Raise/Lower)
- III. Forward/Reverse (if specified)
- IV. Auto/Manual /Test mode

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- V. Local/Remote
- VI. Emergency stop
- VII. Start/Stop for bypass starter (where specified)
- VIII. Trip-Remote Breaker
- IX. Excitation control system for synchronous motors
- X. Sequential switching of filters

5.6.8 Indications

Vendor shall provide indications as required for normal operation and for ease of maintenance, which shall not be limited to the following indications. Motor running

- I. Motor stopped
- II. VFD System Fault
- III. System ready to start
- IV. AC mains ON
- V. Motor over speed
- VI. Rectifier output 'ON'
- VII. Motor zero speed
- VIII. Remote breaker trip
- IX. Excitation system healthy for synchronous motors



Above indications may be provided as a part of the operator control panel, i.e. door mounted keypad or through hardwired LEDs. LEDs provided for indication shall be cluster type with adequate brightness and minimum 2 Nos LEDs chips per light. LEDs shall be connected in parallel and each LED chip having diameter not less than 3mm.

Potential free contacts for items i to iv shall be wired separately for remote indications in DCS system.

5.6.9 Metering

Digital display of the following parameters shall be as a part of the Operator Control Panel, selectable by the operator.

- I. Output voltage
- II. Output current-VFD model Bypass mode
- III. Output frequency
- IV. Drive thermal state
- V. Motor speed
- VI. Motor energy meter
- VII. Hour Run
- VIII. Voltage and current meter for excitation system of synchronous motor
- IX. KVAR, power factor meter for synchronous motors
- X. Necessary transducer shall be provided with 4-20mA output for indicating motor speed and motor current in DCS unless otherwise specified for other parameters.
- XI.

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5.6.10 Annunciations

Potential free contacts shall be provided for following annunciations and shall be wired up to terminal block for owner's use for remote monitoring:

- I. Rectifier fuse failure/Drive fault
- II. Main AC failure
- III. Inverter fuse failure/Drive fault
- IV. Inverter overload
- V. Inverter high temperature/Drive fault
- VI. Failure of panel cooling system
- VII. Motor failed to start/Drive fault

All drive internal faults will be annunciated as drive fault.

5.7 Fault Diagnostic

Fault diagnostic shall be built into the system to supervise the operation and failure of the system. The information regarding failure of any of the system including, shutdown of the system, shall be available for a period of minimum 4 days (96 hours) after a shutdown, even though no supply would be available to the system. The system may be totally de-energized for maintenance or otherwise. It shall be possible to retrieve the record of events prior to tripping of the system or de-energisation. Auxiliary supply to the system components or to the electronics (firmware) for the diagnostics / display shall be taken care by the manufacturer for this purpose.

5.8 External Power supply for auxiliary and Control Circuit

Control supply for devices external to VFD module i.e contactors control, space heater supply for Motor / VFD, indicating lamps digital meters (Ammeter, Speedometer) etc. shall operate on 240 V control supply derived from single-phase control supply transformer, with switchfuse provided in primary and MCB in secondary, located inside the drive controller.

5.9 Reliability Features

The expected life time of the VFD shall be minimum 20 years. The VFD including all individual components forming part of the system shall have an availability of minimum 0.997 and a minimum MTBF of 4 years.

The controller design shall incorporate the following reliability features:

- Pre-tested components with power components to be 100% tested under dynamic conditions.
- Printed circuit boards shall be computer tested and adjusted.
- Printed circuit boards shall be temperature cycled for a minimum of 40 hours.
- Printed circuit boards shall be treated for tropical, humid and corrosive environment.

5.10 Maintenance features

The controller design shall incorporate the following maintenance features:

Modular construction

Printed circuit boards shall be plug connected.

All components shall be easily accessible.

Standard diagnostics to aid maintenance personnel. These shall include LED or alphanumeric displays, test or measurement points.

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5.11 Painting

5.11.1 After preparation of the under surface, the panel shall be spray painted with two coats of epoxy based final paint or shall be powder coated. The color shade of final paint shall be as RAL 7032, unless specified otherwise. Panel finish shall be free from imperfections like pinholes, orange peels, runoff paint, etc.

5.11.2 All metal surfaces shall be thoroughly cleaned and de-greased to remove mill scale, rust, grease and dirt. Fabricated structures shall be pickled and then rinsed to remove any trace of acid. The under-surface shall be prepared by applying a coat of phosphate paint and a coat of yellow zinc chromate primer. The under-surface shall be made free from all imperfections before undertaking the finishing coat.

5.11.3 All unpainted steel parts shall be zinc passivated, cadmium plated or suitably treated to prevent rust and corrosion. If these parts are moving elements, then these shall be greased.

6.0 INSPECTION, TESTING AND ACCEPTANCE

6.1 All tests shall be carried out at the manufacturer's works under his care and expense. The tests shall be witnessed by an inspector of PDIL/ Owner or of an agency authorized by the owner. Prior notice of minimum 4 weeks shall be given to the inspector for witnessing the tests.

6.2 During fabrication, the drive shall be subject to inspection by PDIL / Owner, or by an agency authorized by the Owner, to assess the progress of work, as well as to ascertain that only quality raw material is used.

6.3 All Routine & Type Tests shall be conducted as per the NIT for MV variable frequency drive as per IEC 61800-2. Moreover, combined test for VFD and motor at vendor's works shall be carried out.

6.4 String Test with driven equipment

If a string test with driven equipment is specified in the data sheet of the driven equipment, it shall be carried out with the job equipment.

7.0 SPARES

7.1 Commissioning Spares: Commissioning spares, as required, shall be supplied with the main equipment. Item-wise list of recommended commissioning spares shall be furnished for approval.

7.2 Spare Spares for 2 Years operation (Mandatory), as specified shall be supplied.

7.3 Recommend 2 years Operational Spares (other than mandatory spare) alongwith recommended quantity & item-wise unit price shall be furnished.

7.4 All spare parts shall be identical to the parts used in the equipment.

8.0 DRAWINGS

Vendor shall submit to Purchaser, for approval, before completion of manufacturing and assembly of equipment following drawings and literature.

(i) Installation and maintenance manual including trouble-shooting chart.

(ii) Panel drawings and cable schedule

(iii) Block diagram and control logic.

9.0 CERTIFICATION

The motors and associated Variable frequency drive system equipment shall have test certificates issued by recognized independent test house (CIMFRI BASEEFA/ LCIE/UL/FM or equivalent). All indigenous motors shall conform to Indian Standards and shall be certified by Indian testing agencies. All motors (indigenous and imported) shall also have valid statutory

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approvals as applicable for the specified hazardous location. All indigenous flameproof motors shall have valid BIS license and marking as required by statutory authorities.

Also the motor nameplate shall clearly indicate that the motor is suitable for operation with variable frequency drive along with VFD make and model number.

10.0 PACKING AND DESPATCH

All the equipment shall be divided in to several shipping sections for protection and ease of handling during transportation. The equipment shall be properly packed for selected mode of transportation i.e. ship/rail or trailer. The equipment shall be wrapped in polyethylene sheets before being placed in wooden crates/cases to prevent damage to the finish. Crates/cases shall have skid bottoms for handling. Special notations such as 'Fragile', 'This side up', 'Weight', 'Owner's particulars', 'PO nos. etc., shall be clearly marked on the package together with other details as per purchaser for scrutiny. The equipment may be stored outdoors for long periods before installation. The packing shall be completely suitable for outdoor storage, in areas with heavy rains/high ambient temperature.

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1.0 SCOPE

The intent of this specification is to define the requirements for design, manufacture and supply of Flame Retardant type PVC sheathed cables for use in plant communication and fire alarm systems and Jelly filled telecommunication cables.

2.0 CODES AND STANDARDS

2.1 The equipment shall comply with the requirements of the latest revision of the following standards issued by BIS and DOT, unless otherwise specified:

2.1.1 BIS standards:

IS-694	PVC insulated cables for working voltages upto and including 1100V.
IS-1554 (Part-I)	PVC insulated (heavy duty) electric cables-(Part-I for working voltages up to and including 1100V).
IS-5831	PVC insulation and sheath of electric cable.
IS-8130	Conductors for insulated cables and flexible cords.
IS-9938	Recommended Colours for PVC insulation for LF wires and cables.
IS-10418	Drums for electric cables.
IS-10462 (Part-1)	Fictitious calculation method for determination of dimensions of protective coverings of cables:(Part-I Elastomeric and thermoplastic insulated cables).
IS-10810 (Part-58)	Methods of test for cables (Part 58. Oxygen Index test).
IS-10810 (Part- 61)	Methods of test for cables (Part 61. Flame retardant test)
IS-10810 (Part-62)	Methods of test for cables (Part 62. Fire resistance test for bunched cables).
IS-12444	Continuously cast and rolled electrolytic copper wire rods for electrical conductors.

2.2 DOT Standards:

GRJWIR-06/03	Specification for cable - switchboard (Screened and Unscreened) Generic Requirements.
G/CUG-O1/02	Specification for solid polythene insulated fully filled, Polythene sheathed underground telecom cables.

2.3 In case of imported cables, standards of the country of origin shall be applicable, if these standards are equivalent to or stringent than the applicable Indian standards.

2.4 The cables shall also conform to the provisions of the Indian Electricity rules and other statutory regulations currently in force in the country.

2.5 In case Indian standards are not available for any material, standards issued by IEC / BS / VDE / IEEE / NEMA or equivalent agency shall be applicable.

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2.6 In case of any contradiction between various referred standards/ specifications/ datasheets and statutory regulations the following order of priority shall govern:

- Statutory regulations.
- This specification.
- Codes and standards.

3.0 SITE CONDITIONS

Cables shall be suitable for installation in following conditions:

- i. Above ground in open-air locations (trays / ducts) in tropical, humid and corrosive atmosphere prevalent in refineries/petrochemical plants with severe weathering and exposure to solar radiation.
- ii. Directly buried in underground trenches, conduits with uncontrolled back-fill and possibility of flooding by water and chemicals.
- iii. Unless otherwise specified, the design ambient air temperature of 45° C / ground temperature of 30° C.
- iv. Cables shall be operating near electromagnetic radiations due to high voltage installation and other wireless equipments. Adequate screening shall be provided to make build the electromagnetic immunity.

4.0 TECHNICAL REQUIREMENTS -NON JELLY FILLED CABLES

4.1 Conductors

4.1.1 The size of conductor shall be as per job requirement.

4.1.2 The conductors shall consist of annealed, high conductivity solid copper wire, smoothly drawn, circular in cross-section, uniform in quality, free from defects and uniformly coated with pure tin and shall conform to Cl. 3.0 of DOT specification GR/WIR-06/03. For telecommunication cables conductor shall be 0.5 mm and for PA system conductot dia shall be 0.6 mm as minimum. For fire larm cables size of conductor shall be chosen based on sum of the current drain of all field points in that circuit.

4.2 Insulation

4.2.1 The core insulation shall be with PVC compound applied over the conductor by extrusion.

4.2.2 PVC insulation, when used shall meet the following requirements:

Conductor Diameter (Area)	Type of Insulation	Thickness of Insulation
Upto 0.63 mm (0.3mm ²)	Type-2 of Table-3 as per IS-13176	As per Table-I of DOT Specs. GR/WIR-09/02
Above 0.63mm (Above 3.0 MM ²)	Type-A as per IS-5831	Table-2 as per IS-1554 (Part-I)

4.2.3 The colours used for insulation shall conform as nearly as practicable to the standard colours as per 18-9938. The wire insulation shall have colours in accordance with Table-2 of DOT specification GR/WIR-06/03. The applied colour shall neither have deleterious

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effect on the electrical, mechanical or ageing properties of basic insulation nor shall get damaged by any friction etc.

- 4.2.4 For single pair cables, the colour shall be incorporated in the insulation.
- 4.2.5 For multi pair cables, cores shall have uniform pattern of continuous spiral (Pitch not exceeding 25mm) to facilitate easy identification. This may be done by the application of one or more coloured strips on a base colour or by direct extrusion.
- 4.2.6 Alternately, colouring may consist of concentric coloured rings or dots or dashes on the base colour. The coloured rings, dots or dashes shall have a width of not less than 1.0mm and shall be repeated along the length of the insulation at an interval not less than 15mm and not more than 25mm.
- 4.2.7 The dots or dashes shall be applied on diametrically opposite sides of the insulation, so that all colours are visible when the insulation is viewed from any side.
- 4.3 **Twisting**
- The two insulated conductors of a pair shall be uniformly twisted with a suitable right hand lay, which shall not exceed 80mm.
- 4.4 **Core Formation**
- The core formation shall conform to C1.6.0 of DOT specification no. GR/WIR-06/03.
- 4.5 **Screen**
- 4.5.1 Unless otherwise specified the cables used for fire alarm and detection shall be provided with overall screen. The screen shall be of aluminium tape with minimum thickness of 0.04mm. The overlap shall be minimum 3mm for cables up to 50 pair & minimum 6mm for cables above 50 Pair. The screen shall be backed by an outer protective layer of 0.13mm PVC tape or other non hygroscopic material lapped applied longitudinally or helically with overlap.
- 4.5.2 The cables shall be provided with a drain wire. Drain wire shall have a minimum cross-section of 0.5mm², shall be composed of multistrand bare tinned annealed copper conductor. The drain wire shall be in continuous contact with the aluminium side of the overall screen. The drain wire resistance including screen shall not exceed 30 ohm/km.
- 4.6 **Ripcord**
- A non-metallic ripcord of suitable quality shall be laid longitudinally under the inner sheath & screen. The ripcord when pulled shall cut through the sheath and strip the core.
- 4.7 **Inner Sheath**
- 4.7.1 An extruded inner sheath of type ST1 PVC, as per IS-5831, with minimum thickness as per Table-4 of IS-1554 (Part-1) shall be applied over the laid up core, by extrusion to fit closely on it.
- 4.7.2 The inner sheath shall be as circular as possible. It shall be possible to remove the inner sheath without damage to the insulation.
- 4.7.3 When one or more layers of non-hygroscopic tape is helically applied over the laid up cores, as a binder, the thickness of such tape(s) shall not be construed as a part of the inner sheath.

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4.8 **Armour**

- 4.8.1 The cables shall be provided with armouring, made of hot dip galvanised steel wire /strip over the inner sheath.
- 4.8.2 The armour shall be by means of *104mm* thick round wires for cables with under armour diameter upto 13mm. For cables with an under armour diameter above 13mm, the armour shall either be of steel strip or round wire with thickness as per IS-1554 (Part-1).

4.9 **Outer Sheath**

- 4.9.1 The cables shall be provided with an extruded PVC sheath for external protection. The PVC shall be type ST1 PVC, as per IS-5831.
- 4.9.2 The other sheath shall be with oxygen index 29 at $27\pm 2^{\circ}\text{C}$ and possess flame retardant properties meeting the requirements of IS 10810 Part-62 category - AF. In addition, suitable chemicals shall be added to the PVC compound of the outer sheath to protect the cable against rodent and termite attack.
- 4.9.3 The thickness of outer sheath shall be as per IS-1554 (Part 1).
- 4.9.4 The outer sheath shall fit tightly on the armour and shall be applied in such a manner that no undue residual strain is left in the material.
- 4.9.5 The outer sheath shall be grey in colour except for cables to be used for fire alarm system where it shall be red.
- 4.9.6 Sequential marking of the length of the cable, in meters, shall be provided on the outer sheath at every one meter. The marking shall be legible and indelible by suitable method.
- 4.9.7 The overall diameter of the cables shall be strictly as per the values declared in the technical information furnished along with the bids, subject to a maximum tolerance of ± 2 mm.
- 4.10 **Cable Capacitance**
- 4.10.1 The core to core capacitance of the cables shall not exceed *100nF/Km* at 1KHz.
- 4.10.2 The core to screen capacitance for the screened cables shall not exceed *250nF/Km* at 1KHz.

5.0 **TECHNICAL REQUIREMENTS FOR JELLY FILLED CABLES**

- 5.1 Jelly filled telecom cables shall in general conform to the requirements of DOT specification G/CUG-01/02, unless otherwise specified in this specification.

5.2 **Conductors**

- 5.2.1 The conductors shall consist of annealed, high conductivity solid copper wire, smoothly drawn, circular in cross-section, uniform in quality, free from defects and uniformly coated with pure tin and shall conform to cl. 3.0 of DOT specification G/CUG-01/02.

5.3 **Insulation**

- 5.3.1 Each conductor shall be insulated with insulating grade PE conforming to C1.4.0 of DOT specification G/CUG-01/02.

5.4 **Twisting**

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The two insulated conductors of a pair shall be uniformly twisted with a suitable right hand lay, which shall not exceed 150mm.

5.5 Core Formation

The core formation shall conform to C1.6.0 of DOT specification *G/CUG-01/02*.

5.6 Filling Compound

5.6.1 The cable shall be filled with a suitable stable water resistant compound, which shall be compatible with the insulation, binders and tapes used in the cable.

5.6.2 It shall be homogeneous and uniformly mixed material containing an anti-oxidant.

5.6.3 The compound shall not obscure the identification of the colour of the insulation of the conductors.

5.6.4 It shall not contain dirt, metallic particles or other foreign matter.

5.6.5 The compound shall be readily removable from the insulated conductors by wiping.

5.6.6 It shall be free from any unpleasant odour and shall have no toxic or dermatic hazards.

5.6.7 The flash point of the compound shall not be less than 200°C.

5.6.8 The volume Resistivity measured at 100°C shall not be less than 1010 ohm-ern.

5.6.9 The permittivity at 1 MHz tested as per ASTM 0-924 shall not be greater than 2.3 at 20°C.

5.7 Core Wrapping

At least one closed helical or longitudinal application of a non-hygroscopic and non-wicking polyester tape or tape of any other suitable material shall be provided over the cable core.

5.8 Screen

5.8.1 The cables shall be provided with overall screen. The screen shall be of aluminium tape with minimum thickness of 0.2mm. The overlap shall be minimum 3mm for cables having maximum diameter over inner sheath < 30mm & minimum 6mm for cables having maximum diameter over inner sheath ~ 30mm. The screen shall be coated with 0.05 mm nominal thickness polythene/copolymer on both sides. The thickness of the composite tape shall be 0.3mm±15%.

5.8.2 The aluminium tape shall be electrically continuous throughout the length of the cable.

5.9 Inner Sheath

5.9.1 The inner sheath shall be as circular as possible and free from pinholes and other defects. It shall be possible to remove the inner sheath without damage to the insulation.

5.9.2 The inner sheath shall be of polythene conforming to type 03C or H03C of BS 6234 and shall contain a suitable antioxidant system. The material shall be virgin as per ASTM 0-883 and meet the following requirements.

Density 0.910 to 0.940 *g/lee* for 03C and > 0.940 *g/lee* for H03C

Melt Flow index Maximum 1.0 g/10 minutes (190 °e, 2160 g load)

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5.9.3 The thickness of inner sheath shall conform to Table - 6 of DOT specification no. *G/CUG01/02*.

5.9.4 The maximum diameter over inner sheath shall conform to Table - 7 of DOT specification no. *G/CUG-O 1/02*.

5.10 **Armour**

5.10.1 The cables shall be provided with bedding and armour over the inner sheath.

5.10.2 The bedding shall consist of two close helical lappings of polythene or polypropylene tape. Each tape shall be applied with a minimum of 5% overlap.

5.10.3 The armour shall be made of hot dip galvanised steel tape of thickness as per Table - 8 of DOT specification *G/CUG-01/02*.

5.11 **Outer Sheath**

5.11.1 The external protection shall consist of a polythene sheath conforming to the material specification defined in Clause 5.9 above.

5.11.2 The thickness of outer sheath shall conform to Table - 9 of DOT specification *G/CUG-01/02*.

5.11.3 The outer sheath shall be as circular as possible and free from pinholes and other defects. It shall be possible to remove the inner sheath without damage to the insulation.

5.11.4 The outer sheath shall be grey in colour except for cables to be used for fire alarm system where it shall be red.

5.11.5 The maximum diameter over outer sheath shall conform to Table - 7 of DOT specification *G/CUG-01/02*.

5.12 **Cable Capacitance**

The average mutual capacitance of the pairs measured at 800 to 1000Hz shall be 52 ± 3 nF/km.

However, the mutual capacitance of individual pairs shall be within the limits of 52 ± 4.5 nF/km.

6.0 INSPECTION, TESTING AND ACCEPTANCE

6.1 The cables shall be tested and examined at the manufacturer's works. All the materials employed in the manufacture of the cable shall be subjected to examination, testing and approval by PDIL/Owner. Manufacturer shall furnish all necessary information concerning the supply to PDIL/Owner's inspectors. The inspector shall have free access to the manufacturer's works for the purpose of inspecting the process of manufacture in all its stages and he will have the power to reject any material, which appears to be of unsuitable description or of unsatisfactory quality.

6.2 The following acceptance tests shall be conducted on the completed jelly filled cables as per the test procedures given in DOT specification *G/CUG-01/02* and this specification:

- i. Measurement of diameter of conductor, over inner sheath & over outer sheath.
- ii. Measurement of Thickness of insulation, inner sheath, screen, armour & outer sheath.

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- iii. Measurement of Resistance of conductor.
- iv. Measurement of Resistance unbalance.
- v. Continuity Check & Measurement of Resistance of Poly-al tape.
- vi. Colour coding.
- vii. Conductor continuity test.
- viii. Mutual Capacitance test.
- ix. Capacitance Unbalance test.
- x. Cross talk test.
- xi. Attenuation test.
- xii. Insulation resistance test.
- xiii. Dielectric strength test.
- xiv. Drip test.
- xv. Armour Galvanisation Test.
- xvi. Conductor Annealing Test.
- xvii. Measurement of drum length.

6.3 The following tests shall be conducted on the completed non jelly filled cables as per the test procedures given in DOT specification GR/WIR-06/03 and this specification:

6.3.1 **Acceptance tests:**

- i. Measurement of diameter of conductor, over inner sheath & over outer sheath.
- ii. Measurement of Thickness of insulation, inner sheath, screen, armour & outer sheath.
- iii. Measurement of Resistance of conductor.
- iv. Colour coding.
- v. Conductor continuity test.
- vi. Mutual Capacitance test.
- vii. Capacitance Unbalance test.
- viii. Insulation resistance test.
- ix. High Voltage test.
- x. Armour Galvanisation Test.
- xi. Conductor Annealing Test.
- xii. Measurement of drum length.

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6.3.2 Special Tests

The non jelly filled cables shall also be subjected to following special tests.

- i. Oxygen Index test as per IS-I 0810 (Part 58).
- ii. Flammability test on finished cable as per IS-I0810 (part 61 & 62).

The special test shall be conducted on one sample from each lot. The sample will be selected by the inspector.

7.0 PACKING AND DESPATCH

- 7.1 Cables shall be despatched in non-returnable wooden drums of suitable barrel diameter, securely battened, with the take-off end fully protected against mechanical damage. The wood used for construction of the drum shall be properly seasoned, sound and free from defects. Wood preservatives shall be applied to the entire drum. Ferrous parts used shall be treated with a suitable rust preventive finish or coating to avoid rusting during transit and storage.
- 7.2 On the flange of the drum, necessary information such as project title, manufacturer's name, type, size, length of cable in meters, drum no., cable code, BIS certification mark, gross weight, 'Owner's particulars', 'P.O. numbers' etc., shall be printed. An arrow shall be printed on the drum with suitable instructions to show the direction of rotation of the drum.
- 7.3 Cables shall be supplied in drum lengths of 1000 meters, if not specified otherwise.
- 7.4 For non jelly filled cable, PVC / rubber end caps shall be supplied free of cost for each drum with a minimum of eight per thousand meter length. In addition, ends of the cables shall be properly sealed, with caps, to avoid ingress of moisture/water during transit and storage.
- 7.5 For jelly filled telephone cables, the ends of the cable shall be sealed by thermo shrinkable end caps of adequate wall thickness. Alternately ends may be sealed by enclosing them in rubber or PVC caps of wall thickness not less than 1.8mm. The caps shall be secured to the outer sheath with hose clips or ties or black adhesive tape or heat shrinkable sleeves.
- 7.6 The cables may be stored outdoors for long periods before installation. The packing shall be suitable for outdoor storage in areas with heavy rains / high ambient temperature, unless otherwise agreed.

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TECHNICAL SPECIFICATION

CAPACITOR BANK & ASSOCIATED EQUIPMENT



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ANNEXURE - I	DOCUMENTATION FOR CAPACITOR BANK & ASSOCIATED EQUIPMENT

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1.0 SCOPE

- 1.1 This standard covers the technical requirements of design, manufacture, testing at works and delivery in packed condition of “ Indoor type Shunt Capacitor Bank & Associated Equipment” required for system power factor improvement.
- 1.2 This standard shall be read in conjunction with relevant part of Design Philosophy - Electrical.
- 1.3 The capacitor bank and associated equipment shall generally consist of the following.
- i) Basic Star connected capacitor bank
 - ii) Basic capacitor unit with built in fuse
 - iii) Discharge resistor
 - iv) Series reactor
 - v) Residual V. T. for mounting voltage unbalance
 - vi) Set of Raychem make heat insulated sleeved of suitable voltage rating for bus bars.
 - vii) Copper bus bar interconnecting the basic units.
 - viii) Set of supporting insulators
 - ix) Hot dip galvanised Steel stand/racks / cabinets of mounting capacitor units complete with interconnection insulator etc.
 - x) Door limit switch
 - xi) Control panel for automatic operation
 - xii) Any other equipment not specified, but required for safe & proper operation of the system.

2.0 STANDARDS TO BE FOLLOWED

- 2.1 The design, manufacture & testing of the equipment covered by this specification shall comply with the latest issues of following Indian standards, unless otherwise specified.

IS: 13925-1,2,3	/IEC	Shunt Capacitor for power system
60871		
IS:5553/IEC60289	/	Series reactors
IEC60076-6/IEC 726		
IEC60186		Voltage Transformers
IEC:593/IS 12672		Internal Fuse for shunt capacitor
IS/IEC:60947		Switch gear and control-gear for voltage up to & including 1000V & 1200V DC
IS/IEC:60947		General requirements for switchgear and control-gear for voltage not exceeding 1000V & 1200V DC
IS :9921		AC Isolator & Earthing switches for voltage above 1000V
IS 2099/ IEC 60137		Bushing for voltage above 1000V
IS 13067		Impregnant For power capacitors
IS 5		Colour of mixed paints
IS 2629		Recommended practice for Hot-Dip Galvanizing of Iron and Steel
IS 4759		Hot-dip zinc coatings on structural steels and other allied products.
IS 60270		High Voltage test technique-Partial Discharge measurements
IS 8084		Interconnecting Bus bars for AC voltage above 1 kV up to and including 36 kV.

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IEEE 1036	Guide for application of shunt power capacitors
IEEE 18	Standard for shunt power capacitors
IE Act	Indian Electricity Act

2.2 The design & operation features of equipment shall also comply with provision of the latest issue of the Indian Electricity Rules & other relevant statutory acts & regulation. The supplier shall, wherever, necessary, make suitable modification in the equipment to comply with the above.

2.3 Wherever, any requirement laid down in this standard differs, from that in Indian standard specification, the requirement specified herein shall prevail. Equipment complying with equivalent IEC standards shall also be acceptable.

3.0 SERVICE CODITIONS

3.1 Ambient Conditions

These shall be as indicated in Design Philosophy - Electrical.

3.2 System Details

These shall be as indicated in Design Philosophy - Electrical.

4.0 OPERATING REQUIRMENTS

4.1 The capacitor bank and associated equipment shall be suitable for operating at the specified rating continuously with the specified voltage and frequency variation under the ambient condition without exceeding the permissible temperature rise and without any detrimental effect on any part of equipment.

4.2 The capacitor bank and associated equipment shall be suitable for parallel switching and withstand the thermal and dynamic stresses caused by transient during switching operations.

5.0 GENERAL DESIGN FEATURES

5.1 Capacitor Unit

5.1.1 The capacitor bank / sub bank shall comprise of appropriate number of basic single phase units & which shall be connected in star formation to obtain rated KVAR at rated voltage.

5.1.2 Each unit shall have required number of capacitor elements housed in hermetically sealed, leak proof, sheet steel container. The container shall be provided with suitable brackets, supporting insulators, terminal & bushing for external connections.

5.1.3 Each element of basic units has its own built in fuse which shall isolate the faulty element automatically without affecting the healthy elements.

5.1.4 The capacitor units shall have overload capacity as per IS 13925. The capacitor bank shall be suitable for continuous operation at 110% of rated RMS voltage and at 130% of rated RMS current.

5.1.5 Capacitor units shall be all high grade All Polypropylene type with non-PCB base, bio degradable, non-toxic impregnant. The capacitors offered shall be built from best material and shall develop minimum losses. Capacitor bank losses shall be given at



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45°C. Capacitor shall be compact in size, metal enclosed and hermetically sealed. Internal silver wire fuses shall be provided for protection of each capacitor element.

- 5.1.6 The Capacitor bank and associated equipments shall be suitable for parallel switching and withstand the thermal and dynamic stresses by transient during switching operation.
- 5.1.7 All the fasteners and bolts shall be hot dip galvanized or zinc passivated.
- 5.1.8 Capacitors shall be provided with Overpressure protection as necessary for safety. Overpressure switches shall be fitted to the capacitor units and connected to trip the capacitor bank.
- 5.1.9 Each unit shall have required number of capacitor elements housed in sealed, leak proof, sheet steel container. The container shall be provided with suitable mounting brackets, supporting insulators, terminal & bushing for external connections.
- 5.1.10 The indoor capacitor bank units shall be installed in metallic housing with minimum IP-43 protection.
- 5.1.11 Each capacitor unit shall be mounted so that it can be easily removed from the racks and replaced without removing other units, de-assembling any part of the rack.
- 5.1.12 The outside of the capacitor units and other structures should have smooth and tidy look and should be coated with weather-proof, corrosion resistant epoxy paint of light gray shade, shade no. 631 of IS 5. The structure shall be suitably GI coated. Minimum coating shall not less than 600 micron / sq meters.
- 5.1.13 Each element of basic units has its own built in fuse which shall isolate the faulty element automatically without affecting the healthy elements. In case of one element failure, harmful over voltage shall not be generated across remaining elements and shall not make appreciable change in the operation of capacitor bank. An operation of a single fuse element does not cause cascaded fuse blowing. Permissible over voltages and surges do not cause fuse blowing.
- 5.1.14 The operating & design temperature category of the capacitor unit shall be +5°C as per IS-13925 part-1. Only 5°C temperature rise is permissible above the design temperature of 45°C. So maximum temperature in any case shall not exceed 50° C {i.e. 45°C (design) +5°C (temperature rise)}.
- 5.1.15 The capacitor shall have low value of loss which shall not exceed 0.2 watt per KVAR. The loss value of discharge device/resistor and capacitor unit shall be indicated. The tan delta characteristics of the capacitor units shall be furnished. The losses in watts for each capacitor unit including losses in fuses and discharge resistors forming integral part of the capacitors along with losses for series reactor shall be ensured. If these figures of capacitor losses exceed 0.2 watt per KVAR, the capacitors will be liable for rejection. However owner reserve the right to use the faulty capacitor unit till the same are replaced/ rectified. The loss temperature characteristics, characteristics and insulation resistance temperature characteristics shall also be furnished.
- 5.1.16 The bidder shall furnish calculations for rise in voltage in other units in the event of failure of element(s) of a capacitor unit. The maximum rise in voltage shall not be more than 10% of rated voltage even if the entire capacitor unit failed/short circuited and relevant calculations in support of this shall also be furnished.
- 5.1.17 The bidder shall furnish calculation of voltage drop at rated capacitor unit per phase & losses of the reactor.

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5.1.18 For both capacitor and reactor, mounting arrangement and minimum clearance required from live parts shall be indicated clearly and shall be as per Indian Electricity Act/BS162 & IS-13925-Part2 / IEC-60871-2.

5.2 Discharge Device

5.2.1 A suitable discharge resistor of adequate rating shall be permanently connected across the terminals inside the container to discharge the residual voltage to 50V or less within 1 minute for capacitor rated upto 650V and within 5 minute for capacitor rated above 650V.

5.3 PROTECTIVE FUSES

5.3.1 An internal current limiting fuse with high rupturing capacity conforming to relevant IS/IEC and the specific requirements mentioned in IS13925-Part-3/IEC 60871- 3, shall be provided. The characteristics of the fuse shall be such that it shall isolate the faulty unit only, and protect it against mechanical destruction due to internal failure. The fuses shall not melt or deteriorate when subjected to inrush currents which occur during the life of the bank.

5.3.2 The fuses shall not make any healthy capacitor element out of circuit, either in course of isolating the faulty element or due to any external fault.

5.3.3 The selection of fuse to be done in such a manner that characteristic of fuse shall match suitably with over-current withstand characteristic of associated capacitor unit.

5.3.4 The fuses shall be of adequate thermal capacity to cater for the increased heating which may occur due to harmonics and capacitor current fluctuations.

5.3.5 The number of externally connected capacitors and the available short-circuit current of the supply system should not affect the current-limiting of internal fuses.

5.3.6 It may be noted that provided internal fuses do not lead to case rupture.

5.4 Series Reactor

5.4.1 A suitable series reactor conforming to IS: 5553 to limit the inrush current and suppress the harmonics shall also be provided whenever required.

5.4.2 The reactor shall be copper wound, non-magnetically shielded, oil immersed, natural cooled, sealed type and shall be provided with following fittings.

- i) Oil sampling cum drain valves.
- ii) Filter valves with plugs.
- iii) Buchholz relay with shut off valves, air release device & alarm and trip contact.
- iv) Oil temperature indicator with minimum marking.
- v) Oil level indicator with minimum marking.
- vi) Oil conservator complete with drain plugs and oil filling hole with cover.
- vii) Silica gel breather with oil seal & connecting pipes.
- viii) Explosion vent.
- ix) Bi-directional rollers.
- x) Thermometer pocket.
- xi) Radiator with isolating valves.
- xii) Marshalling box.
- xiii) Rating plate, wiring diagram plate & terminal marking plate.
- xiv) Lifting lugs.
- xv) Earthing terminals.

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xvi) Air release device.

xvii) Cable termination arrangement for incoming & outgoing device.

5.4.3 Dry type/ Oil filled reactor shall only be offered. Such reactors shall be class F/H insulated.

5.4.4 The reactor shall have linear volt ampere characteristics upto 150% of rated capacitor current.

5.5 Residual voltage transformer

5.5.1 3 phase dry type residual voltage transformer of adequate capacity to facilitate neutral unbalance protection and rapid discharging of capacitor shall be provided.

5.5.2 The primary winding of voltage transformer shall be star connected while the secondary winding shall be in open delta for connection to neutral phase displacement relay.

5.5.3 The accuracy class shall be 3P for protection & 1 for metering.

5.5.4 RVT shall have primary and secondary windings made of copper.

5.6 Door limit switch

5.6.1 A door limit switch suitable for mounting on the door frame of the capacitor room shall be provided for each bank. This door limit switch shall be used to trip the power supply to capacitors with initiation of opening action of the door of the capacitor room.

5.6.2 A door limit switch shall be totally enclosed in the aluminium / cast iron housing, fully oil, water & dust tight and shall conform to utilization category AC11 / DC11 as per IS: 6875. This shall be fast actuation type provided with 6 sets of 1 NO & 1 NC contacts rated for 5 amps at 415V AC and 1A at 220V DC.

5.7 Capacitor control panel

5.7.1 Capacitor control panel for control, protection and automatic switching operation of MV capacitor bank shall be provided.

5.7.2 Capacitor control panel shall be of dust, damp & vermin proof construction having enclosure class IP-51 as per IS/IEC:60947.

5.7.3 The enclosure shall be fabricated out of the cold rolled sheet steel having minimum thickness of 2 mm. the doors shall have concealed hinges & provided with neoprene gaskets.

5.7.4 The panel shall be liberally designed. All the components shall be accessible from the front. It shall be possible to attend any component without the necessary removing adjacent ones. All the relays, meters, push buttons including lamps etc. shall be flush mounted. The mounting height of components requiring operation & observation shall not be lower than 300 mm & higher than 1800 mm.

5.7.5 The capacitor control panel shall control the capacitor bank which in turn shall have a number of sub banks for easy of control & to maintain the desired power factor under varying load conditions.

The owner shall arrange C.T supply to sense the power factor. Necessary C.T., selector switch, power factor meter and power factor correction relay shall be provided in the control panel. In addition, the control panel shall have Photo manual selector switch and P.F. raise lower push buttons for manual operation. These common features shall be located near the incoming unit.

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- 5.7.6 Each control shall be provided with TPN switch, voltmeter with selector switch, Ammeter with selector switch and other auxiliaries, as required to receive the incoming power.
- 5.7.7 No. of out going feeders for the control panel shall be decided as per the no. of sub banks to be controlled by it. Each feeder shall be provided with TP switch, fuses, contacts, "ON"& "OFF" indication lamps and other auxiliaries as required.
- 5.7.8 Required no. and size of heavy duty double compression type Aluminium cable glands suitable for incoming and out going power and control cables shall be mounted on removal gland plate provided at a minimum height of 75 mm from the bottom of the panel. Crimping type Aluminium and copper lugs for aluminium and for copper cable respectively shall be provided for termination of cables.
- 5.7.9 The control panel shall be complete with its base channels, foundation bolt etc.
- 5.7.10 A continuous earth bus of aluminium, running along the entire length of the lower part of the control panel shall be provided with lugs at two ends for connection with external earth grid. The minimum size of earth bus shall be 150 sq. mm.
- 5.7.11 Components Details
- 5.7.11.1 The switches shall be of capacitor duty type rated for 1.5 times the rated capacitor current with a minimum rating of 25 A and shall conform to IS/IEC:60947.
- 5.7.11.2 The fuses shall be of non-deteriorating HRC link type and suitably rated for capacitor switching. These shall conform to IS: 13703.
- 5.7.11.3 All contactors shall be of capacitor duty type rated for 50% higher than rated capacitor current & shall conform to IS/IEC:60947. Control supply voltage shall be 240V single phase AC unless otherwise stated. One set of NO & NC potential free contacts shall be made available as spare.
- 5.7.11.4 Ammeter, Voltmeter & power factor meter shall be of accuracy class 1.5 as per IS: 1248 of minimum 96 sq.mm size & shall have 0-240⁰ scale.
- 5.7.11.5 The push buttons & selector switches shall conform to utilisation category AC11/ DC11 as per IS: 6875. Contacts shall be rated for 5A at 415V AC and 1A at 220V DC. The push button shall be of momentary contact spring loaded type with a set of 1 NO & 1 NC contacts. The selector switches shall be stay put type and provided with oval shaped handles.
- 5.7.11.6 The signal lamps shall be LED type. Colour of lamp shall be "Red" for "ON" & "Green" for "OFF" signals.
- 5.7.11.7 Terminal blocks shall be pressure clamp type up to 35 sq. mm. cable and bolted lugs type for higher sizes of cables. The minimum current rating of terminal block shall be 16A. 20% extra terminals shall be provided in the terminal block.
- 5.8 **Bus Bars**
- 5.8.1 All bus bars interconnecting the basic units shall be of copper and shall be fully insulated by using Raychem make heat shrinkable sleeves. All bus bar joints and tap-off connections shall be provided with removable FRP shrouds. The sleeves shall be rated to withstand the system Line-to-Line voltage for 1 minute.
- 5.8.2 The minimum clearances shall be as per relevant standards suitable for the nominal voltage of capacitor banks.
- 5.9 **External cable termination**

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- 5.9.1 Each capacitor bank / sub bank shall be provided with proper termination arrangement where terminal connection from all the three phases shall be brought for connection with external cable. The termination arrangement shall include cable glands, cable lugs, termination kits, supporting arrangements etc. complete in all respect.
- 5.9.2 A cable box for termination of control cables shall be provided on the RVT. The cable boxes shall be provided with adequately sized cable entries and suitable double compression cable glands made of stainless steel. Tinned copper lugs shall be provided for the connection of all cable cores.
- 5.10 **Interlocks**
All necessary interlocks to ensure correct & safe operation of capacitor banks shall also be provided.
- 5.11 **Earthing**
Each basic capacitor unit shall be connected to the earth strip provided on the steel racks which in turn shall be connected to the main earth grid through two nos. suitable earth terminals provided on the racks.
- 6.0 **PROTECTIVE SCHEME (PROVIDED BY PURCHASER)**
- 6.1 The vendor shall confirm the adequacy of these protective devices and also suggest the setting and any other additional protective devices required.
- 7.0 **Accessories**
The supply shall include the following accessories.
- 7.1 **Control panel space heater**
The control panel shall be provided with a thermostatically controlled space heater, rated for 240V, 50Hz & controlled through double pole miniature circuit breaker.
- 7.2 **Name plate**
- 7.2.1 All the equipment shall be provided with name plates containing all the information's as per relevant standard.
- 7.2.2 All control switches, push buttons, lamps etc. shall have functional identification labels.
- 7.2.3 Name plate of capacitor control panel shall be of black prespex with white engraving and of minimum 3 mm thickness while those on other equipment shall be of stainless steel.
- 7.3 **Warning Plates**
- 7.3.1 Warning plates shall be provided on the door and inside of the equipment, comprising following information:
CAUTION: HIGH VOLTAGE CAPACITORS.
AT BLOWN FUSES, CHARGES MAY REMAIN
- 7.3.2 The warning plates shall be UV resistant engraved plastic.
- 7.4 **Steel racks**
- 7.4.1 Sheet steel racks shall be provided to house the capacitor units, residual P. T. etc. in tier formation.
- 7.4.2 The racks shall be suitable for assembly at site. The racks & hardware used for assembly shall be hot dip galvanized.
- 7.4.3 The rack shall be complete with rack insulators, foundation bolts or any other hardware etc. for assembly into complete bank.

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7.4.4 Complete assembly of capacitor bank shall be mounted on a pedestal GI frame, which shall be 300 mm high.

7.4.5 Any other accessories required but not specified, shall be supplied to make the capacitor installation complete in all respect and ensure safe & proper operation.

8.0 PAINTING

8.1 The sheet steel enclosure after degreasing, pickling in acid, cold rinsing, phosphatising passivating etc. shall be painted with two coat of anti-rust paints followed by two coats anti corrosive paints.

8.2 Epoxy based paint shall be used.

8.3 All paint shall be carefully selected to withstand tropical heat and extremes of weather. The paint shall not scale off, crinkle or be removed by abrasion due to normal handling.

8.4 Unless otherwise specified, the finishing shade shall be light gray shade no. 631 as per IS: 5.

9.0 TESTS AND INSPECTION

9.1 All capacitor banks and control panel shall be subjected to routine tests as per IS: 2834 and its associated equipment as per relevant standards.

9.2 Additional tests, wherever specified, shall be carried out.

9.3 All the above tests shall be carried out in presence of purchaser's representative. In addition, the equipment shall be subjected to stage inspection during process of manufacture at works & site inspection.

9.4 These inspections shall, however, not absolve the vendor from his responsibility for making good any defect which may be noticed subsequently.

10.0 DRAWINGS AND DOCUMENTS

10.1 Drawings and documents as per Annexure-I shall be supplied, unless otherwise specified.

10.2 All drawings and documents shall have following description written boldly.

- Name of client
- Name of consultant
- Enquiry / Order Number with plant / project name
- Code No. and Description

11.0 SPARES

11.1 Commissioning Spares : Commissioning spares, as required, shall be supplied with the main equipment. Item-wise list of recommended commissioning spares shall be furnished for information.

11.2 Spares for 2 Years Operation (Mandatory), as specified shall be supplied.

11.3 List of Recommend Spares (other than Mandatory Spares) alongwith recommended quantity shall be furnished.

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- 11.4 All spare parts shall be identical to the parts used in the equipment
- 12.0 **PACKING**
- 12.1 All the equipment shall be properly packed before despatch to avoid damage during transport, storage & handling.
- 12.2 The packing box shall contain a copy of the installation, operation & maintenance manual.
- 12.3 A sign to indicate the upright position on the position of the package to be placed during transport and storage shall be clearly marked. Also proper arrangement shall be provided to handle the equipment.

ANNEXURE - I



DOCUMENTATION FOR CAPACITOR BANK & ASSOCIATED EQUIPMENT

Sl. No.	Description	Documents Required (Y / N)		
		With Bid	For Approval	Final
1.	Specification Sheet	N	Y	Y
2.	Technical Particulars	N	Y	Y
3.	General Arrangement Drgs. with Overall dimensions of the following equipment. - Capacitor bank - Reactor - Control panel	N	Y	Y
4.	Foundation plan indicating certified dimensions floor opening, weight, clearance etc. - Capacitor bank - Reactor - Control panel	N	Y	Y
5.	Schematic & wiring diagram	N	N	Y
6.	Descriptive literature of Various equipment	N	N	Y
7.	Installation, operation & maintenance manual	N	N	Y
8.	Guarantee certificate	N	N	Y
9.	Test certificate	N	N	Y
10.	Spare parts list with identification marks	N	N	Y

Note:

1. 4 hard copies & 1 soft copy shall be supplied for approval after order within 4 weeks from the date of LOI.
2. 8 hard copies & 2 soft copies in CD shall be submitted as final documents prior to despatch of the equipment. These shall be made in sets and supplied in fine plastic coated folder.

Y - Yes, N - No



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TECHNICAL SPECIFICATION
FIRE DETECTION AND ALARM SYSTEM





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Abbreviations:

BIS	Bureau of Indian Standards
BASEEFA	British Approvals Service for Electrical Equipment in Flammable Atmosphere
CCE	Chief Controller of Explosives
CFAP	Central Fire Alarm Panel
CMRI	Central Mining Research Institute
CPU	Central Processing Unit
DGFAP	Data Gathering cum Fire Alarm Panel
ERTL	Electronic Regional Test Laboratory
FAT	Factory Acceptance Tests
FDD	Floppy Disk Drive
FM	Factory Mutual
FRP	Fibre Reinforced Plastic
FO	Fibre Optic
GUI	Graphic User Interface
HAB	Hooter acknowledgement box (to mute hooters)
HDD	Hard Disk Drive
ISDN	Integrated Service Digital Network
ITU-T	International Telecommunication Union- (Telecom)
LED	Light Emitting Diode
LPC	Loss Prevention Council
LIFO	Last In First Out
MCP	Manual call point (break glass unit; BGU)
MMI	Man Machine Interface
MR	Material Requisition
Ni-Cd	Nickel Cadmium (battery)
PO	Purchase Order
RF	Radio Frequency
SAT	Site Acceptance Tests
SOE	Sequence Of Event
TAC	Tariff Advisory Committee
UWL	Under Writers Laboratory
UPS	Uninterrupted Power Supply
VRLA	Valve Regulated Lead Acid (battery)
WP	Weather Proof
ZFAP	Zonal Fire Alarm Panel



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1.0 SCOPE

- 1.1. The intent of this specification is to define the functional and design requirements for an Integrated Fire Alarm System for industrial plants and buildings. This specification covers the requirements for selection, design, and engineering, manufacture, testing at vendor's works, supply, installation, testing at site and commissioning of the system.
- 1.2. The Integrated Fire Alarm System shall be microprocessor based analog addressable system comprising of MCP, detectors, microprocessor based Fire Alarm panels, panels, hooters, sirens, exit signs, Loop/network/power cables, earthing, Junction box & associated equipments detailed hereunder and as per codes standards mentioned below and in Project data sheets/ drawings.
- 1.3. The fire alarm system shall integrate

2.0 CODES AND STANDARDS

- 2.1. The system and equipment shall comply with relevant BIS (Bureau of Indian Standards) and other Indian/ International standards, as applicable. In case Indian standards are not available for any equipment, standards issued by IEC/ BS/ VDE/ IEEE/ NEMAINFPA or equivalent agency shall be applicable. In case of imported equipment, the standards of the country of origin shall be applicable if these standards are equivalent or more stringent than the applicable Indian standards.
- 2.2. The equipment shall also conform to the special requirement/ provisions of applicable statutory regulations currently in force in the country.
- 2.3. In case of any contradiction between various referred standards/ specifications/ data sheets and statutory regulations, the following order of decreasing priority shall govern:
- Statutory regulations
 - This specification
 - Codes and standards
- 2.4. The fire alarm system and the components used shall conform to the latest edition of the following and also the other Indian and International Standards as applicable.
- | | |
|--------------|--|
| IS-5 | Colours for ready Mixed Paint & Enamels. |
| IS - 513 | Specification for cold rolled low carbon steel sheets and strips |
| IS/IEC:60079 | Flameproof enclosures for electrical apparatus |
| IS - 1646 | Code of practice for fire safety of buildings (general): Electrical Installations |
| IS - 2175 | Specification for heat sensitive fire detectors for use in automatic fire alarm system |
| IS - 2189 | Code of practice for selection; installation and maintenance of automatic fire detection and alarm system. |
| IS - 3034 | Code of practice for fire safety of Industrial buildings: Electrical generating and distributing stations |
| IS - 3700 | Essential ratings and characteristics of semi conducting devices (Applicable parts) |

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IS - 3826	Connectors for frequencies below 3 kHz General requirements Part-I and tests
IS/IEC:60079	Code of practice for the use of semi-conductor junction devices (Applicable parts)
IS - 5780	Specification for Intrinsically safe electrical apparatus and circuits
IS - 11360	Specification for smoke detectors for use in automatic electrical fire alarm system.
IS - 12459	Code of practice for fire safety in cable runs
IS - 13346	General requirements for electrical apparatus for explosive gas atmosphere
IS-14154 Part 2	Electrical apparatus with protection of enclosure for use in the presence of combustible dust
NFPA 72 Vol 4	National Fire Alarm code
LPC	Loss prevention council recommendations.
BS - 5839	Specifications for manual call points.
BS-EN 50081-1	EMC (Electromagnetic compatibility test)
BS-EN 50082-1	EMC (Electromagnetic compatibility test)

3.0 GENERAL REQUIREMENTS

3. 1 The offered equipment shall be brand new with state of the art technology and a proven field track record. No prototype equipment shall be offered.

Bidder shall consider adequate nos. of Fire Alarm panels which shall be located at plant and control room of building/substation.

Bidder shall also consider repeater panels (min 3 nos.) which shall be installed in fire station. All the fire alarm and repeater panels shall be connected in ring network.



Repeater panel shall be replica of main fire alarm panel.

Minimum 3 nos. Siren shall be provided with 5 Km audio range.

In case of a Fire alarm initiation by a alarm initiating device, the audio-visual fire alarm shall be generated at Fire Alarm Control Panels (FACP) located at each substation & building and repeater panels for each Fire Alarm panel at Fire safety station as well as in CCR which also initiate signal to operate hooters/siren located in various locations in building and plant area.

The Fire Alarm System envisaged for Building shall be "2-Wire Analog Addressable" type.

The communication between detectors and the FACP is by means of digital communication over 2-wire, which further provides power to the detectors, devices & Sounders. There shall be A/D and D/A conversion happening inside the detectors and FACP.

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All the detectors shall be incorporated with microprocessors and shall be provided with Analog to Digital Converter (ADC), which enables the detector to provide linear output corresponding to the quantity of smoke or fire, the detector encounter.

All types of detectors offered will be of restorable type i.e. suitable for operating a fresh after each actuation on alarm without replace mentor adjustment.

The sensitivity of each sensor shall be individually adjusted from the FACP to suit the conditions of each location. Each detector shall have self-test facility, which is monitored in the FACP. Each detector shall have drift compensation.

The response sensitivity shall also be field adjustable and not only from fire panel over a wide range to suit site shall conditions. It be possible to test the sensitivity of a detector in the field. The sensitivity/threshold value of detectors which are cross zoned must be compatible.

The FACP shall also check each sensor for contamination of dust/dirt and give signal for “Service” in case of accumulation of dust/dirt reaches a preset limit.

The fire alarm system shall work without any problem both in networked mode and in standalone mode.

The electronic circuit shall be of solid state and of failsafe design and virtually hermetically sealed to have resistance to humidity and corrosion and to prevent its operation from being impaired by dust and dirt.

The circuit shall be protected against usual electrical transients, electromagnetic and electrostatic interference (EMI&RFI) present in the Building.

Reverse polarity or fault in the field wiring shall not damage the detector.

No moving parts subject to wear & tear shall be provided.

The system shall have following self diagnostic features:

- Detector cabling shall be completely supervised for open circuit and short circuit and exact location of fault shall be displayed in the panel under Trouble/Faults.
- Un-authorized removal of a detector head from its base shall be supervised to give an alarm on the connected control panel.
- Annunciation shall be provided for DC fuse blown and loss of main AC supply etc.
- Alarm verification features.

If the Equipments to be located in hazardous areas, then same shall have test certificates issued by recognized independent test house such as CIMFR, ERTL, BASEEFA, UL, FM or equivalent. All indigenous equipment shall conform to Indian standards and shall be certified by Indian testing agencies. All equipment (indigenous & imported) shall also have valid statutory approvals e.g. PESO, DGMS as applicable for the specified location. All indigenous flameproof equipment shall have valid BIS license and marking as required by statutory authority.

Fire alarm system shall be interfaced with the owner’s system.

The system shall be provided with siren/s to be located at a suitable location/s in the plant and it shall be actuated manually and automatically as selected by operator from Fire Alarm panel located at fire station/ other buildings.



- 3.2 Vendor shall ensure availability of spare parts and maintenance support services for the offered equipment for at least 15 years from the date of supply. The spares shall be available ex-stock with the vendor.
- 3.3 Vendor shall give a notice of at least one year to the end user of equipment and PMC before phasing out the product/ spares to enable the end user to place order for spares and services.
- 3.4 The vendor shall be responsible for design, engineering and manufacturing of the complete system and equipment to fully meet the intent and requirements of this specification and attached data sheets.
- 3.5 All equipment and accessories required for completeness of the system, whether specifically mentioned or not but considered essential for satisfactory performance, shall be included as a part of the offered system.
- 3.6 The system integrator shall coordinate with the manufacturers of various bought-out items associated with the system, as required, and shall freely and readily supply all technical information as and when called for.

4.0 DEFINITIONS

4.1 Hazardous Area

An area in which an explosive gas/ dust atmosphere is present, or likely to be present in quantities such as to require special protection for the construction, installation and use of electrical apparatus.

5.0 SYSTEM AND SITE CONDITIONS

All equipment shall be designed to operate with power supply and site conditions as specified below:

5.1 Input Power Supply

- 5.1.1 Power supply for fire alarm panels shall have battery backup as per IS-2189. Battery AH rating shall be determined on the basis of maintaining the system in normal operation for a period of not less than 48 hours (quiescent condition) and successive full load alarm condition of period not less than 30 min after the failure of normal mains supply.

The switch over from mains to back up, in the event of mains failure, shall be automatic.



Batteries shall be Ni-Cd type. Suitable and adequately rated battery charger shall be supplied as a part of back up battery system.

The secondary power supply capacity required shall include all power supply loads that are not automatically disconnected upon the transfer to secondary power supply.

Battery sizing shall consider the maximum quantity of detector/equipment that can be connected in the loops, as well as 5 hooters and 5 exit signs per loop in Fire Alarm panels. Battery sizing calculations shall be reviewed during detailed engineering and there shall be no cost/time implication for providing adequately sized batteries and chargers of approved rating during the order execution. Separate battery charger shall be provided in case battery charger part of the Fire Alarm panel cannot cater to the boost charging requirement of battery.

An overall ageing factor of 0.8 and a temperature correction factor corresponding to minimum temperature of 5°C shall be considered for battery sizing. The battery calculations shall include a 10 percent safety margin to the calculated amp-hour rating.

Operation on secondary power shall not affect the required performance of a fire alarm system or supervising station facility. The system shall produce the same alarm, supervisory and trouble signals and indications.

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Operation on secondary power shall not affect the required performance of a fire alarm system or supervising station facility. The system shall produce the same alarm, supervisory and trouble signals and indications.
The switch-over from primary source to secondary source, in the event of mains failure, shall be automatic. Battery shall be Ni-Cd type.

5.2 Site Conditions

The offered equipment shall be capable of operating continuously and maintaining its guaranteed performance at the site ambient conditions indicated in data sheet.

Unless specified otherwise, fire alarm panels along with associated hardware shall be suitable for installation and operation in a closed building/ room with restricted ventilation. Any specific requirements for air conditioned/ dust free environment, etc. for the panels, if absolutely necessary, shall be clearly highlighted by the vendor in the offer.

6.0 FIRE ALARM SYSTEM DESCRIPTION

6.1 General

Fire alarm system under this specification is envisaged to provide fire monitoring in industrial plants/ chemical plants/ plant and non- plant buildings. The system shall be designed to detect incipient fires and generate audio/ visual alarm in case of fire.

The system shall consist of automatic fire detectors and manual call point or break glass unit. Automatic fire detectors shall work on the principle of sensing of smoke, heat or infrared rays. Depending on type of smoke, optical or ionization type detectors shall be used. Detectors shall generally be provided in plant/ non-plant buildings. Manual Call Point shall be provided at exit doors of the buildings and at exit route of industrial plants. Number of detectors and break glass unit shall be decided as per guidelines given in applicable codes and standards.



Alarms, if specified, shall be relayed to repeater panel provided in buildings like control rooms/administrative buildings to provide zone wise annunciation. In addition facility shall be provided to actuate siren/ hooter.

For integrated fire alarm system where plant-wide large numbers of fire alarm panels are envisaged, these panels shall be integrated to CFAP, which shall be located in fire station or in administrative control room of the building as per the job requirements. The connectivity shall be achieved using data high way or dedicated cable connection from each fire alarm panel to CFAP. Mimic at CFAP shall be provided for fire/ fault annunciation on geographical location in addition to the text/ LED. If defined, CFAP shall have provision for automatic and manual actuation of plant-wide siren as per operator's choice. Interface with other systems such as telephone exchange/ plant's public address system/Pager system shall be provided for communication required for disaster management.

6.2.3 As specified in data sheet, the system shall be provided with siren/s to be located at a suitable location/s in the plant and it shall be actuated manually and automatically .

7.0 ENGINEERING REQUIREMENTS

vendor shall design entire fire alarm system including design of system architecture with details of integration, cabling requirement and protocol selection etc. Vendor's scope shall also include basic design and preparation of layouts for fire alarm system for plant/ buildings as specified in the data sheet/ purchase documents.

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8.0 ADDRESSABLE FIRE ALARM SYSTEM

8.1 ANALOGUE ADDRESSABLE FIRE ALARM CONTROL PANEL (FACP)

The FACP used in the Building shall confine to the EN54 standards having the following features.



- i) FACP provided shall have the capacity to expand from at least loop for Future expansion.
- ii) Each loop shall accommodate maximum 250 detectors and devices in any combination with a loop length capable up to 2kms with 2Cx1.5sqmm cable. However bidder shall consider maximum number of detectors/ MCP/ addressable devices in a signal loop shall be 60.
- iii) It shall have facility to discriminate between a real fire alarm and false alarms.
- iv) FACP will function as fully stand-alone panel& also networked to other FACPs & repeater with peer to peer communication.
- v) Each FACP shall have redundant controller to takeover in case of a Failure in the Primary Controller and also redundant loop card for each loop to takeover in case of a Failure in the Primary Loop Card.
- vi) Each FACP shall have inbuilt LCD colour touch screen (320*240 pixels) to clearly indicate the location of fire, type of device activated other indications like service requirement of a component, etc.
- vii) In case of a Loop Card Failure, the FACP shall allow to replace the Loop card without switching off the panel and reprogramming.
- viii) The FACP shall be capable of Public Address system integration with the use of RS232/RS485 module or with the use of relays.
- ix) FACPs shall have inbuilt buzzer to alert the personnel in case of maintenance requirement.
- x) FACP shall have facilities for sequence of events to happen in case of fire like closing of fire dampers, shutting down supply fans for HVAC, Deactivating the access control system and activating the hooters with the help of a control relay module provided near the system to be activated.
- xi) The fire alarm control panel shall be suitable for Class-A type of wiring as per NFPA-72.
- xii) The fire alarm control panel shall work on positive sequence as per NFPA – 72.
- xiii) The fire alarm control panel shall be capable of disabling an individual detector, a group and or zone off or building maintenance purposes. Facility shall be provided on the FACP for simulating the fire condition to enable testing of the various alarm circuits.
- xiv) All the fire alarm modules (loop cards, networking cards, and communication card. Etc.) should be hot pluggable and hot swappable to facilitate easy replacement of faulty modules. All the electronic components shall be compatible to non-air-conditioned environment for working satisfactorily.
- xv) The fire alarm control panel normal power supply failure shall be annunciated audio-visually.



- xvi) In case of multiple alarms the multiple alarm indication shall be ON. The multiple alarm indication shall be displayed in chronological order.
- xvii) FACP shall have the facility such that each detector can be identified as a separate zone.
- xviii) The FACP shall be reset only by authorized users after the clearance of a fault.
- xix) Whenever there is a third party actuation to happen, like closing of fire dampers, switching off supply/exhaust units etc, the actuation shall happen only when the fire signal is received from two different initiating devices located in a zone connected to different fire alarm panels .The communication between the FACPs shall happen with two pair cables and the fire alarm status of one panel shall be communicated to the second panel in which the control relay module of the third party device is connected to. Inter panel communication is a must and needs to be provided for controlled actuations .All the necessary systems to ensure reliable communications between panels are to be built into the FACPs.
- xx) FACP shall have the facility to silence/ acknowledge/ reset the alarm. Apart from the FACP.
- xxi) The FACP shall have FALSE ALARM REDUCTION algorithms like.
 - Alarm Verification, Dual Detector/Group Dependency, and Intermediate Alarm Storage to eliminate False alarms due to Dirt/Dust/Disturbance values.
 - EMC/EMI Monitoring - Signal-to noise ratio shall be high. To inform the possibility of a false alarm caused due to interferences from sources such as Motors, power cables, Wi-Fi routers, fluorescent lamps, network switches, mobile signals...etc. The panel shall display the EMI/EMC Current and Average Values reported by the detector. The User/Installer shall have access to this reading during Maintenance (with password protection).
- xxii) When fire condition is confirmed, the following sequence of annunciation will take place on the FACP:

Alarm Condition	Audible Alarm	Visual Alarm
First Fire Condition	ON	ON FLASHING/Description of area of fire origin with detector type
Acknowledge (first Alarm)	OFF	ON STEADY
New Fire Alarm Condition (after acknowledge of First alarm)	ON	ON FLASHING
Acknowledge (New fire alarm)	OFF	ON STEADY
Back to normal	OFF	ON STEADY
Reset	OFF	OFF
Reset Before Normal	OFF	ON STEADY



- xxiii) System shall provide adequate EEPROM size to store minimum of 200 events fire/ fault. The event shall be stored in LIFO structure. All events shall be time stamped. FACP shall have real time clock for event time stamping.

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- xxiv) Software access for either Zone programming or access to plant/ building graphic on monitor shall be password protected. For viewing status of various field devices e.g. fire and fault status password protection shall not be given.
- xxv) Fire Alarm & repeater panels shall be certified/ approved by an international approving agency/ approving agency of country of origin as applicable.
- xxvi) The FACP shall have a process or which shall be of at-least 32bit, which shall be designed to accept all the input and process the outputs within the time stipulated by the standards.
- xxvii) The CPU shall have the facility to communicate with other FACPs and process the fire signals received from other FACPs to actuate a third party device.
- xxviii) The processor shall be designed in such a way that the parameters in the repeater panel shall be refreshed in 1sec.
- xxix) The capacity of the processor shall be adequately designed include all input/output signals and various functional requirements.
- xxx) It shall have its own, built in advanced microprocessor, sophisticated software and extensive memory for storing the logs of alarms, times and action taken report.
- xxxi) Loop module shall have a line length up to 1600m or 3000m depending upon the configuration & cable type. It shall have an LED test button.
- xxxii) The loop module shall be encapsulated & shall be hot pluggable.
- xxxiii) The front fascia of the loop cards shall be visible for easy identification of faults.
- xxxiv) In case of the failure of loop card, it should be replaced without the need of any additional programming.

8.2 Repeater Panels

- i) These panels shall be required for repeat of alarm in buildings/ plant control rooms/Fire station.
- ii) It shall be a LCD touch screen same as main panel. The MMI shall be the same as the main Controller.
- iii) Repeater panels shall be suitable for Wall mounting which will be displayed from all the major entrances and staircases which will enable the staff and fire fighting personnel to exactly locate the fire.
- iv) It shall be compatible to received at a from FACPs.
- v) Audio visual Alarms during fire shall be generated in case of fire.
- vi) All fire alarm panels including repeater panel shall be networked through copper/FO communication cable.
- vii) The Power supply to the Repeater Panel shall be drawn from the Fire Panel
- viii) The Repeater Panel shall display Messages like Alarm & Fault similar to the Main Panel and shall be accessed only by Authorized Users through a passcode.
- ix) The Repeater Panel shall be connected to the Main Panel and other repeater panels in such a way – 1 pt Failure in the cable shall not affect the performance and shall intimate the exact location of failure in all Panels.

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- x) The Repeater Panel shall be equipped with a Key switch that allows Authorized users to Acknowledge/Reset Alarms.
- xi) The Repeater Panel shall be equipped with 2 different power inputs. On failure of primary power, the secondary shall take over.
- xii) The Repeater panel shall allow the users to login locally or login to the remote FACP.
- xiii) The repeater panels shall integrate with the main panels without any additional interface or the bidder shall consider necessary accessories required to complete the system and quote as part of this model.

9.0 INTEGRATION WITH VARIOUS PLANT SYSTEMS

9.1 Fire Alarm System shall have required hardware to have interface with following plant systems as specified in data sheet.

- i. Public Alarm Announcement system
- ii. Paging and plant intercom systems.
- iii. Plant data network
- iv. ISDN telephone exchange and pager system
- v. Fire suppression system
- vi. PLC Data Communication through serial common modbus
- vii Shutdown signals to various air-handling units relative to the zone of fire.
- viii Siren

10.0 PANEL CONSTRUCTION

10.1 Equipment Mounting

10.1.1 All apparatus, display screen, instruments and indicating lamps mounted on the panel front shall be flush mounting type. The external cabling shall not be terminated directly on the base connector of PCBs but shall be terminated on separate terminal block. Further connection to PCBs shall be as per manufacturer's standard. Routine calibration, adjustments, programming and operation shall be accessible from the front of the panel without opening the door. External cabling shall preferably be done from the rear.



10.1.2 Power supply system including battery bank shall be mounted inside the panel.

10.1.3 Doors shall be provided with pistol grip handle with lock. Lamps shall be provided inside the panel to provide adequate light for maintenance of equipments.

10.1.4 Cable entry shall be from bottom unless otherwise specified in the data sheet. Terminal strip shall be provided for incoming / outgoing cables.

10.2 Wiring and Terminals

10.2.1 Wiring within the panel shall be laid in slotted plastic raceways enclosed with cover. Control connections shall be done with 660V grade PVC insulated wires having stranded copper conductors. 1.5mm² size of wire shall normally be used for circuits with control fuse rating of IOA or less. Control wiring for electronic circuits shall be through ribbon

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cable or through copper wire minimum of 0.5mm dia. Panels shall be supplied completely pre-wired, such that only field termination shall be required at site before it is energized.

10.2.2 PCBs for identical functions shall be interchangeable. PCBs shall be plug in type having pin/edge connectors. PCBs shall be suitable for use in tropical, humid and dusty environment. These shall be protected with anti fungus treatment.

10.2.3 Cables shall be terminated on terminal blocks. Clamp type terminals shall be of spring-loaded, stacking type, mounted on rails. Terminals shall be sized to accept, as a minimum 2.5mm² cross section conductors. Not more than one conductor shall be terminated on the outgoing side of each terminal. At least 20 % spare terminals shall be provided in each panel for termination of spare cores of cables.

10.3 Earthing

10.3.1 A common earth bar of minimum 25 x 3 mm. copper or equivalent aluminium shall be provided throughout the length of the panel. All non-current carrying metallic parts of the panel mounted equipment shall be earthed. Flexible jumpers shall connect all doors and movable parts to the earth bus. Two numbers earth lugs shall be provided outside the panel.

The FACP's shall be provided with triplicated earthing terminals on the either side. The grounding terminal G1 shall be for safety grounding, G2 shall be for shield grounding and G3 shall be for signal grounding

10.4 Name Plates / Warning plates

10.4.1 All nameplates for panel shall be engraved out of 3 ply (black-white- black) lamicoide sheets or anodized aluminum. Back-engraved Perspex sheet nameplates will also be acceptable. Engraving shall be done with square groove cutters. Hard paper or self-adhesive plastic tape nameplates shall not be acceptable.

10.4.2 Labels shall be provided for every component on the cards, connecting wires as well as for the terminals in the terminal strip inside the panel. Wiring diagram shall be pasted inside the panel door as required for termination and maintenance.

10.4.3 Special warning plates shall be provided on all removable covers or doors giving access to energized metallic parts above 24 volts.

10.5 Painting

10.5.1 All metal surfaces shall be thoroughly cleaned and degreased to remove mill scale, rust, grease and dirt. Fabricated structures shall be pickled and then rinsed to remove any trace of acid. The undersurface shall be made free from all imperfections before undertaking the finishing coat.

10.5.2 After preparation of the undersurface, the panel shall be powder coated. The colour shade of final paint shall be as approved by the purchaser. The finished panels shall be dried in dust free atmosphere. Panel finish shall be free from imperfections like pinholes, orange peels, run-off paint etc.

10.5.3 All unpainted steel parts shall be cadmium plated or suitably treated to prevent rust-corrosion. Moving elements shall be greased.

11.0 AUTOMATIC FIRE DETECTORS AND ACCESSORIES

i) Detectors for microprocessor shall be addressable type. Detectors shall be plug-in type and shall have twist lock action fitting. Multicolour LEDs provided on the detectors





shall indicate Normal and Alarm state. Essential features of detectors are indicated as below.

- ii) Detectors shall be supplied with mounting bases. Mounting base shall be identical for all type of detectors. Detector housing (body and cover) shall be made up of damage resistant, fire resistant polycarbonate and shall be suitable for either surface or recess mounting. Detector base shall be mounted on Junction boxes having terminals for cable termination. Installation equipment such as GI conduits, GI junction box/ conduit box etc. shall also be included in vendor's scope.
- iii) Detectors shall be suitable for storage at ambient condition specified in data sheet.
- iv) All detectors shall be on the approved list of LPC, UL / FM/ equivalent international approving agency as applicable.

11.1 Intelligent Addressable Dual Optical Smoke/Heat (Multi-sensor) Detector

- i) The Intelligent Addressable Multi sensor Detector with 2 LED's-Infrared & Blue used and shall confine to the relevant standard shaving the following features.
- ii) It shall be combination of Smoke detection and heat detection. The smoke detection system shall work on Light scattering type principle using Infrared & Blue LED's, and the Heat detection system shall be of Rate of rise of temperature and Fixed Temperature.
- iii) The Intelligent Addressable Multi sensor Detector shall be of Spot type and Addressable type.
- iv) The Intelligent Addressable Multi-sensor Detector shall be addressed either by DIP switches or through Programming from the Panel.
- v) The Detector shall monitor EMC/EMI values in the surroundings on a continuous basis and report the current & average values to the panel. The detector and the panel shall together avoid the possibility of false alarm caused due to interferences from sources such as Motors, power cables, Wi-Fi routers, fluorescent lamps, network switches, mobile signals...etc.
- vi) All the detectors shall have a visible multi-color LED to indicate the healthiness/trouble/alarm condition of the detector. The LED shall be located in such away that it shall be visible from all the 360 degree from below. In some cases where the visibility of the detector is obstructed by cable trays, false ceiling etc. Facility for connecting the detector to a response indicator has to be present. The response indicator derives the power to glow from the loop.
- vii) It shall possess False alarm immunity and a superior signal to noise ratio.
- viii) It shall have drift compensation facility built-in.
- ix) The detectors shall communicate the ambient reading to the FACP on time to time basis, and the FACP shall make the decision about the current status of the detector, whether it is in fire/pre-alarm/maintenance requirement etc.
- x) The detector shall have different levels of sensitivity settings based on the application and room where it is installed.
- xi) The detector shall provide a chamber maid plug to blow out the dust/dirt using a blower.
- xii) In case of a failure, panel shall allow to replace the detector with the same type without the need of additional programming
- xiii) The detector shall be programmed to work as Optical only or Thermal only detectors. It shall a provision to switch off any component (optical or thermal) of the detector.

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- xiv) The detector shall work with 2 different sensitivity settings at any point of time and the User shall have access to choose the desired settings without programming or Laptop/PC for configuration.
- xv) The detector shall change sensitivity settings based on day/night mode or with schedules based on the programming.
- xvi) The detector shall have Intermediate Alarm Storage, Dual Detector Dependency, Dual group Dependency features that shall be programmed based on site application.
- xvii) The detector shall be capable of detecting both smoldering fires and open fires and shall be EN54 /VdS approved

11.2 Heat Sensing Cables

Heat sensing cable shall be analogue type. It shall consist of four copper conductors, each covered with a colour coded, negative temperature co-efficient material. The cores shall be twisted together and protected by an outer sheath of high temperature, flame retardant PVC insulation. External mechanical protection shall be provided over the sensor cables. Vendor shall provide control unit for each 100 m length of the sensor cable.

11.3 Manual Call Point (MCP)/Break Glass Unit (BGU)

- i) Manual break glass unit shall be fabricated out of 14-gauge cold rolled sheet steel. Alternately the break glass unit may be made of die cast aluminium alloy such as LM6.
- ii) It shall have IP-55 enclosure and weatherproof construction suitable for outdoor installation. The break glass unit shall have a minimum dimension of 100x100x80mm.
- iii) The box shall be fabricated in such a way it can be mounted flush to the wall or on the surface without any modification. Two nos. 19 mm knockouts shall be provided at the bottom of the box to facilitate cable / conduit entry. The glass shall cover at least 30cm² area and shall have a thickness not exceeding 2mm.
- iv) The box shall have a push button element kept in pressed condition by a glass sheet fitted in the front of the box.
- v) The enclosure shall be painted with fire red colour (shade 536 of IS-5) epoxy painting and an inscription" Break Glass in case of Fire", shall be painted in white letters or riveted on the enclosure by a steel nameplate. A suitable nickel-plated brass hammer, duly chained to the box with stainless steel chain shall be provided with each box for breaking the glass. Each box shall have a distinct identification number boldly painted on it.
- vi) One no. blanking plug shall be provided for 5% of the total quantity of MCPs.
- vii) Hazardous area Break Glass Units shall meet the requirement of clause 13 of this specification.

11.4 Response Indicator

Response indicators shall be provided suitable for wall/ ceiling mounting as required. Response indicator shall be provided where the detector is located either above false ceiling or below false floor or where detectors are not directly visible. The response indicators shall be connected to the detectors directly and shall be complete with terminal blocks suitable to accept cables with up to 1.5mm² copper conductor. In the normal state of detector, the LEO shall flicker, but in the event the detector goes into alarm condition, the LEO shall glow steadily. LEOs shall be red in colour with 5mm dia. as a minimum.